ELECTRICAL WORLD AND ENGINEER

THE CONSOLIDATION OF "THE ELECTRICAL WORLD" AND "THE ELECTRICAL ENGINEER."

ELECTRICAL WORLD AND ENGINEER. NEW YORK, JULY 1, 1899. VOL. 34, NO. 1.

PUBLISHED EVERY SATURDAY BY

ELECTRICAL WORLD AND ENGINEER

(INCORPORATED.)

120 LIBERTY STREET, NEW YORK.

TELEPHONE CALL: 4044 CORTLANDT. CABLE ADDRESS: ELECTRICAL, NEW YORK.

CHICAGO OFFICE, - - - - - - - - - Monadnock Block.
PHILADELPHIA OFFICE, - - - - - - 929 Chestnut Street.

T. C. MARTIN AND W. D. WEAVER, - - - - - - Editors.
T. R. TALTAVALL, - - - - - - - - - - Associate Editor.
CARL HERING, - - - - - - - - - Special Contributor.

J. M. WAKEMAN, - - - - - President and General Manager.
T. C. MARTIN, - - - - - - - - - - Vice-President.
A. C. SHAW, - - - - - - - - - - - - Secretary.

NOTICE TO ADVERTISERS.

Change in advertisements intended for a particular issue should reach the office of the ELECTRICAL WORLD AND ENGINEER on or before MONDAY morning of the week of issue. New advertisements can be received up to 10 A. M. of Tuesday of the week of issue.

TERMS OF SUBSCRIPTION.

United States, Canada or Mexico, - - - - - - - - per year, $3.00
Foreign Countries within the Postal Union, - - - - - - - - - 6.00
Single Copies, - .10

In requesting your address changed give OLD as well as new address.

(Entered as second-class mail matter at the New York Post Office.)

NEW YORK, SATURDAY, JULY 1.

CONTENTS.

	PAGE.
Editorial	1
International Congress of the Paris Exposition of 1900, by Francis E. Drake.	4
The Lighting of New York City	4
Work Done by an Interior Telephone Service	4
The Generating Plant, Distributing System and Transportation Facilities of the Highest Office Building in the World—I	5
Electrical Papers at the Franklin Institute	8
General Meeting of the American Institute of Electrical Engineers	9
Electrical Notes in China—III., by Prof. F. B. Crocker	10
The "Pumping" of Rotary Converters	11
Underground Electrical Construction—II., by L. A. Ferguson	11
The Brooklyn Electrical Supply System for Lighting and Power—I., by W. S. Barstow	13
The Minneapolis, St. Paul & Suburban Railway	16
Current News and Notes	16
LETTERS TO THE EDITORS:	
The Feasibility of Telephone Repeaters, by F. Jarvis Patten	19
Theory of the Induction Coil, by I. P. Wintringham	19
What Is a Two-Phase Current? by Charles A. Perkins	20
Two-Phase vs. Three-Phase Systems, by J. Blondel	20
Energy Direct from Carbon, by Chas. J. Reed	21
Digest of Current Electrical Literature, compiled by Carl Hering	21
New Books	24
Integrating Wattmeters for Alternating Circuits	24
A Novel Prismatic Electric Sign	25
Telephone Equipment of the University Club, New York	26
Sneak Current Arrester	26
The New Bullock Motor Factory, Cincinnati	27
Columbia Electrical Supply Company	28
Chains for Power Transmission, Elevating and Conveying Purposes	28
News of the Week	29

INFLAMMABLE CARS.

Several instances have been noted lately of street cars catching fire and burning up where they stood. The newspapers attribute the "accident" usually to the blowing of a fuse, but it must be confessed that the warm puff of shellac vapor that salutes the nose occasionally as a car goes by intimates to an electrical man that the motor itself is fairly hot, in spite of the cool breeze that necessarily accompanies its motion along the track. And then again after rain or snow, it is to be expected that a short circuit will develop on the motor or its connections, if they get saturated with moisture.

Be the causes what they may, the car conflagrations appear far too numerous. It would seem that the electrical defects now causing them were readily remediable, and even if they were not, it does not follow that, as we have seen lately, a car should burst suddenly into full flame, alarming its passengers and arousing the whole neighborhood. There must surely be means and material that can render electric motor cars as slow to catch fire as an ordinary steam locomotive; and while electrical engineers are arriving at better methods of car insulation, it would seem well to study out also improved construction in which wood and other inflammable material would play an exceedingly minor part. We have no doubt that this is a point to which our progressive electrical and car manufacturers are giving thought in their newer product, embodying the lessons of the last few years, not only in their cars but in their automobiles.

CHEAP POWER FOR CURRENT GENERATION.

In another of his extremely interesting articles on conditions in the Far East, Prof. Crocker this week touches upon the question of cheap labor and cheap power. Not without an accent of surprise, natural in an American making his first actual acquaintance with tropical conditions, he tells how he has seen street conveyances and ferryboats propelled by human power; and he notes the curious fact that at Hong Kong, men and women carry brick and sand a thousand feet up to the top of the Peak, although a steam-driven cableway is in operation. And yet Prof. Crocker remarks at the same time, though by no means self-contradictorily, that electric railways have an immense future in Oriental countries because of the indolence of the people.

As the mineral resources of the East open up, and cheap coal becomes available, we may expect to see much of this manual and pedal labor disappear, but in the meantime, some of it might be used profitably in the generation of electric current. During the recent British campaign in the Soudan, a Röntgen ray outfit when badly needed was driven by a bicycle with excellent results, and in this country there are said to be a good many little electroplating machines operated in the same manner. Not long ago, the suggestion was seriously made on the hot frontier of India to utilize some of the convict labor there in driving dynamos there which would furnish light at night and drive motors swinging the punkahs. Fuel of every kind at those points is prohibitively expensive, and the transport of

illuminating oil is slow and costly. There seems no good reason why some such plan should not be tried and made quite successful with the aid of storage batteries. The convicts would work no harder than on an ordinary treadmill, and the burden of the white man and white woman holding the Indian frontiers of civilization would be appreciably lightened.

INSULATORS AS TARGETS.

One of the nuisances to which electrical engineers are subjected in long-distance transmissions employing high electric pressures is the malicious breaking of insulators by careless and ignorant sportsmen. It is bad enough to have the delivery of power interrupted by natural causes such as the splitting of an insulator from undue electrical or mechanical strains, but it is too bad to have a breakdown due to the heedless action of a man with a gun who has more marksmanship than sense. In the early days of telegraphy, when the telegraph insulator was a new toy set upon a pole, the same trouble was largely experienced. This was especially the case with the bright white porcelain insulators which attracted the eye and made a prominent object for the sight of a rifle.

The trouble was at one time so serious as to give rise to characteristic types of European insulators that have largely come into use; namely, the unattractive brownstone ware insulator of Great Britain, and the iron-hooded or ironclad insulator of the European continent. The large porcelain insulators of power transmission systems are especially lustrous to behold and luscious to aim at. They are frequently installed in rough and sparsely settled districts where the sporting impulse being keen and the law-abiding impulses weak, the nuisance is sometimes so pronounced that the transmission line has to be practically patroled by watchmen during the day. It is undesirable both for mechanical and electrical reasons to cover these large insulators with metal hoods. Possibly some amelioration could be effected by choosing a dull color, and a few arrests and penalties might also serve as an occasional safeguard.

AUTOMOBILE VICTORIES.

The opposition of the New York and Chicago park authorities to the automobile is decidedly weakening. In this city, a furtive intimation has been given out that the board is only waiting to be coaxed by some representative body like the Automobile Club. As a backdown, this is amusing. Why a club member should have any more rights in Central Park than an ordinary citizen passes understanding. It is to be wished that some one with nerve and courage would personally take the matter in their own hands as Messrs. Woods and Osburn have done in Chicago, and by challenging the board to a proof of the contention that a law or valid ordinance is violated, compel a cessation of the obstructionist nonsense on the part of the authorities.

Messrs. Woods and Osburn have done a great public service in pushing this matter to an issue in Chicago, and the prompt rally of public opinion to their side shows that the cause of common sense must win emphatically. The exclusion of drays from a park any one will approve. The division or diversion of congested traffic is comprehensible. But the exclusion of vehicles that are more subject to control than any others ever used before, and that so far from wearing roads away improve all over which they pass, is one of the pieces of Dogberry wisdom that New York and Chicago should be the last cities to exhibit. The only argument of any weight is that the noise of the automobiles might scare horses. But the same horses trot side by side with the automobiles just outside the park walls without getting scared, and it is one of the obvious things that in the next few years such horses as do remain in city streets must accustom themselves perforce to the presence of the ubiquitous automobile. One concern alone has orders for nearly 4000 such vehicles, and the number of all kinds in use for pleasure purposes alone in the next two years may easily reach 25,000.

We in America are in fact still very much behind our French friends, who at a recent automobile exhibition saw nearly 500 exhibitors assembled, and took the gathering quite as a matter of course. Now that the inventive talent of our country, from Edison down, is enlisted in the improvement of automobiles, the strides toward a higher perfection will be rapid, particularly we believe in the electric types and classes.

THE DIGEST.

Since our Digest was started over six years ago, changes in its scope and arrangement have been made from time to time with a view to meeting the requirements of the greatest number of our readers. But much of the difficulty which has been encountered still exists and, in fact, has become greater each year; this difficulty is, to give due notice to all the current articles and notes of interest, which are rapidly increasing in number. If all these were mentioned, the Digest would soon degenerate into a mere index of titles and references, and it would then no longer be entitled to be called a digest. On the other hand, to give such a full abstract of each article, as some of our readers have requested, would fill all the columns of each number to the exclusion of other matter. A medium between these two extremes must therefore be chosen, and it has consequently been decided to make the abstracts more brief and more numerous, to increase the number of references, to confine the scope more to the purely electrical field and less to the allied branches, and to omit all mention of a large class of notes, short articles, etc., of relatively small interest. Formulas and illustrations will be used more freely when they are thought to be of special interest.

The American electrical contemporaries, which for some time past have not been included among those to be abstracted, will again be noticed, and a few more journals will be added to the already large list. In general, the papers read before American societies are duly noticed in our other columns, and they are therefore not included in the Digest. Articles and papers in the more accessible journals will be noticed more briefly than those in foreign journals not so easily obtained. Reprints and translations in accessible journals, of articles which originally appeared in publications that are not so easily obtained, will as heretofore be duly noticed, but papers of the leading foreign societies appearing in several contemporaries will as a rule be mentioned only once. Articles of which a mere abstract is of little or no value as, for instance, descriptions of plants, long theoretical discussions, etc., the original of which would be consulted by those interested, will be noticed only briefly. The length of the abstract or reference in the Digest is therefore no measure of the value of the article. We trust that, with these few changes, the value of this department will be enhanced.

WATER-POWER ELECTRIC INSTALLATIONS.

It is remarkable how wide a range of hydraulic conditions are successfully met by combinations of the turbine and the dynamo. In the West we have heads of water of as much as 1600 feet in the penstocks, driving impulse wheels direct connected to generators. In the East, we have heads of as low as 10 feet driving turbines with vertical shafts connected to generators through mitre gearing. At the present rate of installations, we may expect that in the course of the next few decades most of the great rivers of the world will be harnessed to dynamos, and will distribute power to distances of many miles. Anyone who visits these water power installations will be struck with the simplicity of the apparatus and system. The

generators are usually mounted directly on the turbine shafts, and, unless the distance of transmission is over, say, 15 miles, the line wires may be connected directly to the armature terminals. Step-down transformers do the rest. There is occasionally, however, some little disparity between the hydraulic and electric machines, owing to the fact that they are made by different manufacturers and are usually first combined on the designs of the engineer in charge of the installation. There can be little doubt that in the course of time and experience, the two machines will be more closely associated into a single unit by understanding between the manufacturers.

As the distance of transmission increases, and the electrical pressure is raised, two principal difficulties increase; namely, the insulation difficulty on the one hand, and protection from lightning on the other. The higher the pressure employed, the more closely does the electric energy delivered resemble miniature lightning in its properties, and the greater the difficulty of keeping out atmospheric electricity and keeping in the electricity generated. The feature of greatest complexity which such a system possesses, lies in the means of converting alternating currents to direct currents for electric railway service. If the electric railway had come into use about twenty years later, it is quite likely that it would have been established upon the alternating current system, instead of on the direct-current system. In that case, no converters would have been required, except for storage batteries and electrolytic processes. As it is, however, converters must play a prominent part in supplying traction power for many years.

NEW ARGUMENTS IN THE TWO-PHASE VS. THREE-PHASE DISCUSSION.

There will be found among the letters to the editors of THE ELECTRICAL WORLD AND ENGINEER in this issue, a communication from the well-known French scientist and engineer, M. A. Blondel, which differs from some of the neutral communications which have been published heretofore in this controversy, by upholding so strongly the superiority of one of the two systems—in this case the three-phase—that further discussion of some of the points involved is warranted. M. Blondel proceeds to point out the fallacy of the peculiar prevailing belief in the comparative independence, so far as regulation is concerned, of the phases of a two-phase system. This conception of the subject is probably due, in part at least, to the absence of mutual induction between the armature circuits of a two-phase machine and in part to a superficial conclusion with regard to Y connected coils of transformers, that, since each branch of the Y is a common return of the other two, any inequality of the currents must occasion serious unbalancing.

Considering the mutual effect of the several phases in the armature of a machine, it should be noted that the fall of voltage with the load is only in part due to the ohmic drop and that of self-induction, and is in large part due to the reaction of the armature currents upon the field strength. In the case of a two-phase machine, any load or lagging current on one phase affects the field strength just as much, and consequently affects the other phase practically as much as it does in a three-phase machine. As to the other cause of the fallacy mentioned above, even though one branch of the Y is necessarily a common return for the other two, this does not necessitate that the currents in the three branches should be equal. If a Y connected machine supplies a delta connected load and one side of the delta is more heavily loaded than the others, an increased current will flow through two branches of the Y without seriously disturbing the equality of voltages.

M. Blondel's letter also points out several differences between polyphase current practice on the Continent and in America. One of these is the almost universal use there of multiphase transformers, the great advantage of which is stated to be the mutual voltage balancing effect of the three cores. Another difference is the present tendency he mentions toward the use of compounding, which has not as yet been taken up in this country. To be sure, we compound small machines by means of a rectifier and composite winding, but this method has not been found applicable in large polyphase generators. The practice which M. Blondel refers to is probably the use of an exciter, specially wound to be automatically affected by the main load, which was recently described in THE ELECTRICAL WORLD, Jan. 14, 1899, page 58.

MEASUREMENTS OF HIGH ELECTRIC PRESSURES.

An instrument that is much needed at present is one which will measure and record electromotive intensity, or the electromotive force per unit of length. It is this electromotive intensity, or gradient of electromotive force, which determines the mechanical rupture of dielectrics, and it is also this electromotive intensity which determines the operation of the coherer in wireless telegraphy. It would be better to have an instrument which would measure this quantity without recording it, than to have none at all. At the present time we are practically retarded in a great many directions, both of theoretical and practical development, by our ignorance of the magnitudes of the electric forces which are established in dielectrics. In the case of electric waves, these forces are but of momentary duration, and there is, of course, special difficulty in the measurement of such evanescent forces. But in the case of steadily impressed E. M. F.'s we ought to be able to measure and record electromotive intensity, in order to determine the relative electric strength of insulating materials. The influence which electromotive intensity exerts upon the optical properties of transparent insulators has been suggested for this purpose, and attempts have been made to render such apparatus practical, but the effect is relatively so minute, and such powerful intensities have to be employed, that very little success has yet been attained in this direction.

When we apply electromotive intensity to a dielectric, we are practically ignorant of the effects produced, until we reach the dielectric strength of the substance and it becomes punctured. Long before the rupture point has been reached, however, we might expect that a reliable instrument would show that the limit of elasticity in the dielectric had been reached. While, however, the intensities which electrical engineers employ in high-pressure generators and transformers amount to many kilovolts per centimeter, the intensities to which the coherer has to respond in wireless telegraphy must be very small, being probably considerably less than a volt per centimeter, so that the range of intensities which are employed at the present time, and which instruments should be capable of measuring, is already very wide. To go still further, the electromotive intensities which are present in the waves of light ought to be capable of direct measurement in some way, but at the present time we can only estimate them indirectly. This is a great drawback. It is to be feared that we never shall make much progress with the popularizing of the electromagnetic theory of light until we have found some means of actuating purely electric or magnetic apparatus by a beam of light. Theoretically, we ought to be able to show the effects of the alternating magnetomotive intensity and also the effects of the alternating electromotive intensity, which we know are directed at right angles to each other from instant to instant, and which are always active in the plane of the wave front, or perpendicular to the beam.—Wanted: "An electromotive-intensity measurer; no matter how narrow the range or crude the results, no criticisms will be offered."

International Congress of the Paris Exposition of 1900.

By FRANCIS E. DRAKE.
(Director of Machinery and Electricity for the Commissioner General of the United States.)

The Universal Exposition of 1900 is certain to prove a Mecca to a great number of scientific men and engineers. This gathering together of technical men from all parts of the world justifies the French electricians in their efforts to organize an International Electrical Congress, which has already received the official patronage of the French Government. In previous conferences questions of units and nomenclatures have been settled by international agreement, to the great advantage of all concerned. Since the international electrical congress at Chicago in 1893, there have been unexpected discoveries in the application of what seemed once to belong to pure science and an extraordinary expansion of the various electrical industries. Engineering practice has thus awakened an interest in a great number of problems on which it will be interesting and profitable to have the views of technical authorities. The discussion of the proposed congress will, therefore, have a character at once both industrial and economic.

The work before the proposed congress is provisionally divided as follows:

1. Scientific methods and instruments of measurement.
2. Production of electrical energy, transformers, distribution, electric lighting, traction.
3. Electro-chemistry, electro-metallurgy, accumulators, electric furnaces.
4. Telegraphy, telephones and various applications.
5. Electro-physiology.

The congress will last one week, beginning Friday, Aug. 18, 1900.

The administration of the exposition has arranged with the Commissioner General for the United States for the appointment under him, of an official delegate, with headquarters in Paris, and through him all correspondence and plans of the organization may be transmitted. The Commissioner General has wisely named as his official delegate, under the agreement, the Assistant Commissioner General, who is in constant touch with the authorities and abundantly able to conduct any conferences which may be required prior to the opening of the congress.

The method of choosing delegates will be proposed by the authorities at a later date, and a subscription for membership has been placed at 20 francs, merely a nominal fee to apply toward the current expenses of the reporting staff, etc.

Any communications which may be directed to the Commissioner General, at either New York or Chicago, will receive prompt consideration. It is to be hoped that an early conference may be held with the American Institute of Electrical Engineers, and other scientific bodies interested in this work, so that proper representation from the United States may be assured.

The Automobile Arrests in Chicago.

The cases of Messrs. H. G. Osburn and G. F. Marchant were brought up in Chicago last week, the charge being that of deliberately violating an ordinance which forbade the use of automobiles on the South Side parkways. Mr. Osburn was represented by Mr. W. Clyde Jones, on behalf of the American Vehicle Co. Mr. Marchant is the superintendent of the Woods Motor Co. (Fischer Equipment Co.). It was shown before the court that the ordinance had not been passed and that no law had been violated, and Mr. Marchant's case was dismissed. For Mr. Osburn, a continuance was asked with bail in $300, with the idea of surrendering him on a writ of habeas corpus to be argued before Judge Gibbons on the main question. It is stated from Chicago that the matter is not likely now to be pushed further by the South Side park authorities.

A Telephone Quad Wanted.

Last week we commented editorially on the statement of President C. J. Glidden, of the Erie Telephone and Telegraph Company, which he had confirmed, namely, that he would give one million dollars for a telephone repeater. We now have word from Mr. Glidden, at Detroit, stating that he makes the same offer for a telephone quad. It is two million pities to see such offers go begging. Is invention dead, or is the thing an impossibility?

The Lighting of New York City.

At the present time, according to the report of Commissioner Kearney, of the Department of Public Buildings, Lighting and Supplies, Greater New York has 25,054 public gas lamps, 1415 naphtha lamps, 387 Welsbach naphthas and 4324 arcs. There were about 155 miles of subways laid in 1898, for electric light and power and for telephone and telegraph companies, giving, at the end of the year, a total of 2124 miles of subways in existence; in these were being operated about 75,000 miles of electrical conductors. The department caused the removal of 681 poles and 105 miles of overhead wire by the various companies, and its inspectors removed 41.71 miles of overhead wires from streets in Manhattan and the Bronx. The number of electric lights in the entire city on Dec. 31 was 809,896, all of them incandescent but 21,801. The city is criticised for allowing Police and Fire Department wires to remain above ground.

The Superintendent of the Bureau of Lamps and Gas reports an expenditure during the quarter of $410,755.80, and for the year of $1,216,954.26, with outstanding liabilities of $8,152.68, leaving a balance of $65,129.06 of the appropriation for lamps and lighting. Of this amount $38,000 has been transferred to other accounts, leaving expended the sum of $27,129.06.

Work Done by an Interior Telephone Service.

During the recent electrical exhibition in Madison Square Garden, the New York Telephone Company had in service, for the benefit of exhibitors and without charge, one of its interior telephone systems. The quantity of work done was surprising, to say the least, and the exhibitors were greatly pleased by the convenience afforded them. The data of the calls in and out has been compiled. It appears that the company's board handled a total of over 6500 originating calls during the 23 days of the exhibition. The system was installed and working by the evening of the opening day, and worked until the close of the exhibition. There were connected to the switchboard 28 extension stations in exhibitors' booths and in the exhibition departments, and five stations in the company's space, four of these in silence booths for general use. The local service was free to all comers, exhibitors and visitors alike. The average daily traffic was 282 outward calls, and from 90 to 100 inward calls. The largest day's traffic was 490 on May 25 outward calls, and the smallest, on Decoration Day, 135 outward calls. Of the 23 full days, the traffic on eight days was over 300 outward calls, on two days over 400 outward calls, and on only three days did it fall below 200 outward calls. No accurate count was kept of inward calls, but in the estimation of the operators, they averaged about one-third as many as the outward calls. The switchboard was connected by eight trunk lines to the Eighteenth Street exchange. This equipment of trunks handled the traffic without any difficulty.

Independent Telephone Convention.

A special despatch from our Chicago representative, dated June 27, says: The convention of the Independent Telephone Association has opened in accordance with the published programme, which is being carried out very closely. The attendance at the present time is about 350, and more are expected. Those in authority consider the meeting a great success and say it will have a good effect.

Manhattan Elevated Power House.

President George J. Gould, of the Manhattan Elevated, gave out the subjoined information on June 27: The Manhattan Railway Company has secured a location for its power house at Seventy-fourth and Seventy-fifth streets and the East River. The plot has a frontage of 204 feet on the river by 570 feet on the side streets, enough space to install the power for the elevated system and allow for an increase in growth of 50 per cent. The contract for 9000 tons of third rail weighing 100 pounds per yard has been given to the Lackawanna Steel Company, the delivery and installation of which will commence in September. During the past week competitive bids have been received from the largest engine builders and boiler factories in the country, which are now being tabulated and compared for the action of the Executive Committee.

The Generating Plant, Distributing System and Transportation Facilities of the Highest Office Building in the World.—I.

IN many respects the modern office building is one of the most interesting developments of the times, embodying as it does the solution of special problems in each of the numerous arts concerned in its construction.

These problems have become more intricate in their bearing on the possibility of the structure itself, the greater the number of stories and consequently the larger the number of persons to be transported and accommodated. For that reason, principally, a description of the generating and distributing plant installed and recently completed in the great Ivins Syndicate or Park Row Building in New York City, must prove interesting as well as instructive. This building, a perspective view of which is shown in the initial cut and a typical floor plan in Fig. 1, is located on Park Row, directly opposite the Astor House and faces the large open space at the south end of the Postoffice Building.

The principal dimensions of the building are as follows: Park Row front, 104 feet; Ann Street front, 20 feet; Theatre Alley front, 48 feet; height, 26 stories from curb to main roof, five stories in each tower and one small story in each dome, or lantern, besides basement and sub-cellar below the curb, making a total of 34 stories from foundation to the extreme portion of the accessible interior. The height from the head of the piles to the base of the flagstaff, which is the highest accessible portion of the building, is 424½ feet. From the street level to the same point is 390¾ feet. From the street level to the top of the main cornice is 336 feet. Pile foundations are used throughout this entire building, whose maximum total weight is computed at about 65,200 tons.

Each of the nearly 1000 offices in the structure is finished in hard wood, is electrically lighted, steam heated, supplied with hot and cold water, connected by telephone with an information bureau at the entrance and has a messenger call box. In all 7500 incandescent lamps are used; dynamos having a total capacity of 575-kw; 2 boosters; a 500-kw-hour battery plant; 900-hp battery of boilers; 1000-hp in engines, 23 electric motors and 15 elevators of all sizes, from small dumb waiters to sidewalk ash hoists of 8000 pounds lifting capacity. The estimated number of inhabitants with all offices rented is 4000.

BOILERS, PUMPS, HEATING, VENTILATION AND AUXILIARY EQUIPMENT.

The boiler room, shown in Fig. 4, is situated in the centre of the sub-cellar, east of the generating plant, and contains three boilers aggregating nine hundred horse-power. They are of the Babcock & Wilcox water tube type, and have a total heating surface of 9615 square feet with 203 square feet of grate surface. Each boiler is provided with three Potter Mesh separators, one located in each steam drum. This arrangement assures the delivery of dry steam to the engines and prevents all possibilities of entrained water gaining admission to the cylinders and blowing out cylinder heads or otherwise disabling or possibly wrecking the plant. The boilers are connected up so as to be interchangeable with the two 16-inch power mains, which are in duplicate, so as to provide against any shutting down of the plant in case of leakage or necessary repairs to the main steam piping. Each main is constructed of extra heavy wrought iron pipe and is designed to carry a continuous working pressure of one hundred and thirty pounds to the square inch; separate branches being taken off for each engine, pump, etc. The steam piping connecting the boilers with the engines are also made extraordinarily heavy and are furnished with eccentric flanges, which prevents the formation of water pockets, by keeping the lower side of the mains in a perfectly straight line. Another method resorted to for obtaining absolutely dry steam was the installation of Straight Line separators, made by Joseph De Rycke, New York. The separator consists of a shell or casing containing a double-ended cone. On this cone there are cast a number of knife-edged wings, extending spirally along its exterior, the annular space between the cone and the shell of separator being equal at its smallest cross-section to that of the steam pipe, from whence it is greatly enlarged. At the outlet end of the shell there is also an annular space, formed by an inwardly extending outlet pipe.

On entering the separator the steam is spread and thrown outward by the cone and given a centrifugal motion by the spiral wings. These wings are constructed with curved surfaces tangential to the cone, which is an important factor in the construction of the separator, as it materially aids in producing an outward flow to the water or grease, etc., which meets curved angular wings along which it flows outward to the shell of the separator, and is collected in a well, where it is entirely isolated from the flow of the dry steam, which passes off through the inverted pipe. To still further guard against the accumulation of condensed steam in the main steam pipe, an excellent drain is effected by tapping a three-inch pipe into its termination and using this for the pump supply. This novel scheme not only keeps the main absolutely dry, but avoids dangerous "dead ends," so common in a great many installations. The steam pipes are covered with "Nonparcil" sectional cork covering, which greatly diminishes condensation and consequently materially decreases the coal consumption.

The temperature of the boiler and engine rooms is quite low, as both are ventilated by means of exhaust fans operated by electric motors, the air being circulated through galvanized iron ducts.

FIG. 1.—TYPICAL FLOOR PLAN.

To prevent undue heat radiation the boiler room has a double ceiling, composed of T-bars suspended from the main ceiling and covered with wire netting on which sectional magnesia blocks one and one-third inches thick are laid, and plastered with two coats of magnesia plaster, so as to inclose a 3-inch insulating air space.

The boilers are operated by natural draft, supplied by a steel smokestack which runs from the bottom to the top of the building.

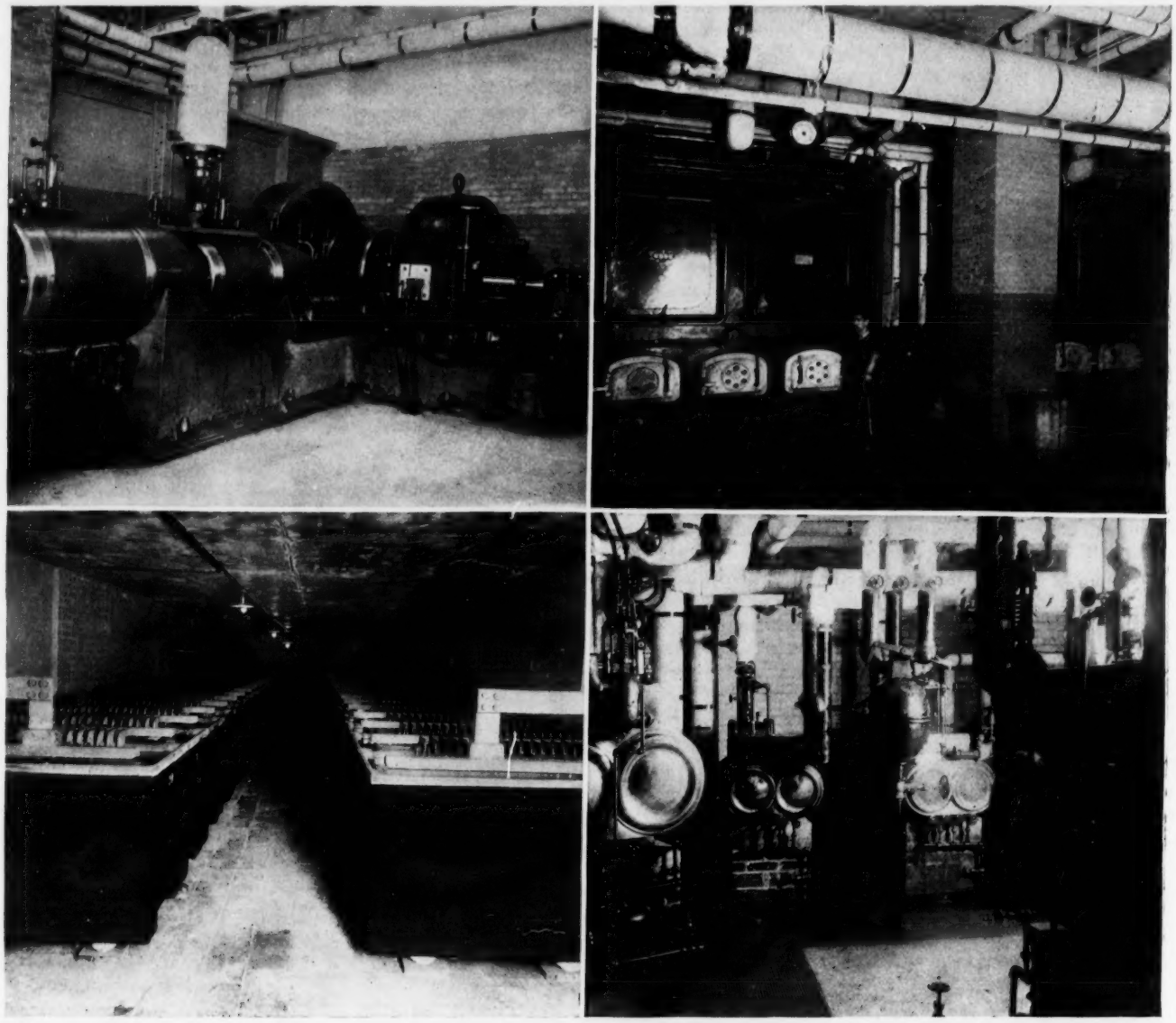
it is made in sections one story high, the sections being riveted together with expansion joints at every third and fourth story. Each section of the chimney is supported directly on the floor beams belonging to its section. It is made of steel plates ⅜ inch thick for the first 100 feet, then 5-16 inch for the next 100 feet, and ¼ inch for the remainder.

The pump room, Fig. 5, contains seven Deane pumps, which are used as follows: Three 7½"x5"x6" and two 14"x7"x10" supply the boilers with feed water and are cross-connected with the Croton supply, the clean water drips and the house returns; delivery to the boilers being made through a 1000-hp Berryman feed water heater, 13'—6" in height and 4'—6" in diameter, the exhaust steam entering by means of a 14-inch pipe and the hot feed water leaving through a 3-inch pipe. In addition to this is a 1000-hp. "Ward" combination feed water purifier of the Ward &

2-inch branches for the lines of toilet rooms are connected to it by tees at the centre, and 23 one-inch branches for wash bowls, etc., on the other lines are symmetrically connected to the drum on both sides by horizontal nipples screwed to the thickness of the drum. The hot water supply pipe is put in the centre of the set of cold water pipes, but has really no connection with the cold water drum.

The hot water boiler is ordinarily supplied from the thirty-first story small tank, but has an additional connection to the cold water drum, so as to be supplied from the main tank if necessary. The hot water tank contains two 8-pipe brass steam coils, which can be supplied with either live or exhaust steam, and have their connections made through the top and bottom of the tank instead of at the ends as customary.

The system devised to provide for taking care of and utilizing the drips from the high pressure lines, the steam separators and



THE SYNDICATE BUILDING PLANT.

Fig. 2.—Corner in the Engine Room.
Fig. 3.—Storage Battery Room.
Fig. 4.—Boiler Room.
Fig. 5.—Pump Room.

Upright Company's type. Both the heater and the purifier are provided with by-pass connections, so that any repairs can be made without interference in the operation of the plant.

The water supply of the building, flowing freely under street pressure, through the filters, is discharged through a 4-inch pipe and a system of ball cocks into an open steel cylindrical suction tank of 20,000 gallons capacity. This tank is set in the basement near two 6"x4"x6" cross connected house and fire pumps, either of which delivers water from the tank to the twenty-sixth story tank, from which it is brought down about 350 feet through a 5-inch pipe to the cold water drum in the cellar, whence the distribution to all parts of the building is made. This drum is set above the hot water heater, which partly supports it. The drum is made of extra heavy 6-inch steel pipe, very thick, capped at one end, and flange connected to the 5-inch tank riser at the other end. Two

the engine cylinders is very complete and economical, for the reason that two tanks are used, one for receiving the clean water, which is controlled by a Kieley automatic pump and governor and returned to the boilers; the other for discharge to the sewer

There is further, a grease extractor 3'—6" diameter, and 8'—0" long, through which all the exhaust steam from the engines and pumps passes. The clean water is then returned to the house service lines and to the feed water heater by means of 14-inch pipes connected to the top of the extractor. The grease floats on top of the water and is caught by a suitable trap.

All the wase oil or drip from the machinery runs into a tank located beneath the engine room floor, and is pumped into a Columbus oil fitter, to be used over again—a saving of 80 per cent. of the oil being thereby effected.

The building will be heated to 70 degrees in zero weather by

direct low pressure or exhaust steam radiators, operated by a 16-inch main in the basement; this main being cross-connected with the exhaust from the engines and pumps. The circulation, however, is greatly accelerated by the application of the "Paul system," which consists briefly of radiators, piping and pumps, so arranged that the radiators are at all times kept free from air and condensed water, allowing the exhaust steam to rise freely without causing back pressure at the engines and pumps. As the heating apparatus has no openings into the offices to be warmed, the air is not vitiated by foul gases escaping from the air valves, and there is no dripping to stain carpets or ceilings. The temperature of the steam is constant, no pressure being required to circulate it, and the disagreeable dry "burnt" air in the rooms is entirely avoided. There are no volumes of air locked in portions of coils or radiators, but every square inch of heating surface is rendered uniformly efficient while steam is being used in the steam distributed. The condensation from the heating system is returned to the boilers by pumps.

inch stroke, shown in Fig. 2. There is also one 40-kw Westinghouse booster dynamo direct connected to a 9½-inch by 12-inch engine of the same type as those above and a 20-kw booster driven by a 32-hp electric motor shown in Fig. 8. All the engines are equipped with the inertia governor which is so rapidly being adopted for those installations that require the closest regulation of speed under trying changes of load. The plant furnishes light for the offices and building, and power for the elevators and ventilating service.

In order to insure an equalization of load and to act as a reservoir of electrical energy for supplementing the plant in case of necessity as well as to supply a few lights and an elevator with current during the night, a storage battery of 58 chloride accumulators has been installed. The battery room shown in Fig. 3, is situated under the Park Row sidewalk in the sub-basement and contains besides the cells, a ¼-hp motor and an air compressing pump for producing a sufficient air pressure (8 to 10 pounds), and an adequate

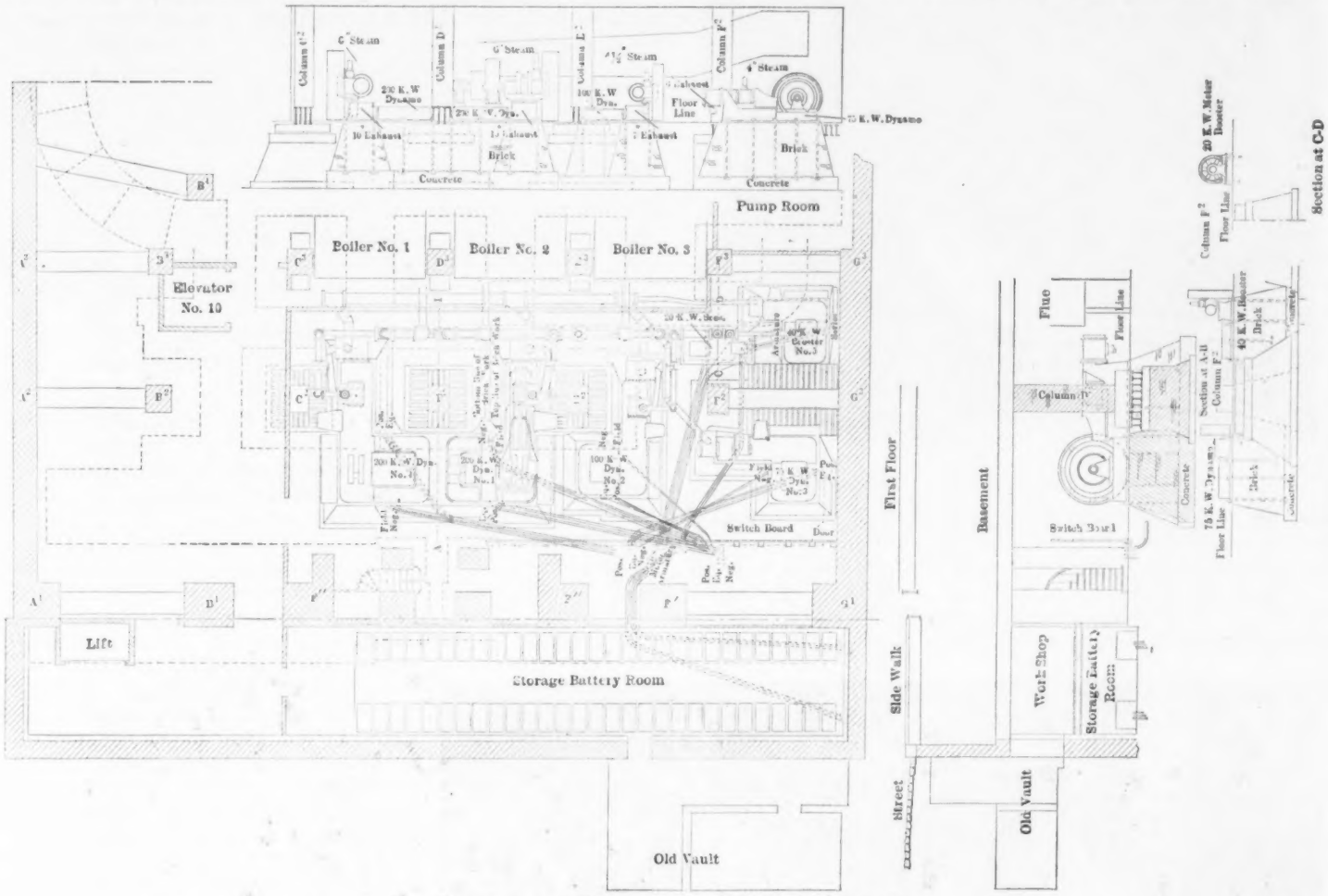


FIG. 6.—PLAN AND ELEVATION OF GENERATING PLANT.

The lavatories are ventilated by means of galvanized iron ducts running from the basement to the roof, where the exhaust fan operated by electric motors is located. The plumbing system is of the ordinary modern equipment for high office buildings, with screwed galvanized steel pipe sewers that empty directly into the street sewers. For the sub-cellar the drainage is collected into a steel tank cesspool, and periodically pumped into the main sewer.

GENERATING UNITS, BOOSTERS AND STORAGE BATTERIES.

The engine room, shown in plan and elevation in Fig. 6 occupies the southwest corner of the Park Row side of the sub-basement in line with and west of the boiler and pump room. The electrical generating plant was provided by the Westinghouse Electric and Manufacturing Company and consists of two 200-kw, one 100-kw, shown in Fig. 7, and one 75-kw Westinghouse standard compound wound generators, 120 volts, direct connected to Dick & Church tandem compound horizontal engines, built by the Phœnix Iron Works Company, of the following capacity: Two engines of 320 I. H. P., with a high pressure cylinder 15½ inches in diameter and a low pressure cylinder 27 inches in diameter by 18 inches stroke, and one of 160 I. H. P., with cylinders 10-inch and 17-inch by 12-

supply for blowing air into the solution of several or all the battery cells simultaneously for the purpose of agitating the solution and equalizing its density. The capacity of the cells is 500-kw hours, and the normal discharge rate is 350 amperes for 10 hours, but it is capable, however, of discharging at five times this rate and of a momentary discharge of 2000 amperes for periods not exceeding 30 seconds.

The two booster dynamo outfits are intended to operate in connection with the storage battery so as to act as a compensation in equalizing the load fluctuations and in maintaining the output at the dynamos relatively constant. The two machines are intended to be interchangeable, to serve for varying outputs, and the dynamo portions are substantially alike. The field of the dynamo portion in both cases has a series and shunt winding, the two connected differentially. Both windings can be varied, the shunt winding being varied by a rheostat in the usual way, while the series winding is varied by a series of equalizer shunts.

In practice, the series winding of the booster dynamo is arranged so as to take either the whole or a determinate portion of the current fed from the dynamos into the power circuits, and this winding, and the e. m. f. due to it, are made responsive thereby to the

conditions and fluctuations of the load on the power circuits. The shunt winding is connected across the terminals of the battery or excited from the dynamo bus-bars. The armature of the booster dynamo is connected in the battery circuit. By making the proper adjustments so as to regulate the relative effects of the series and

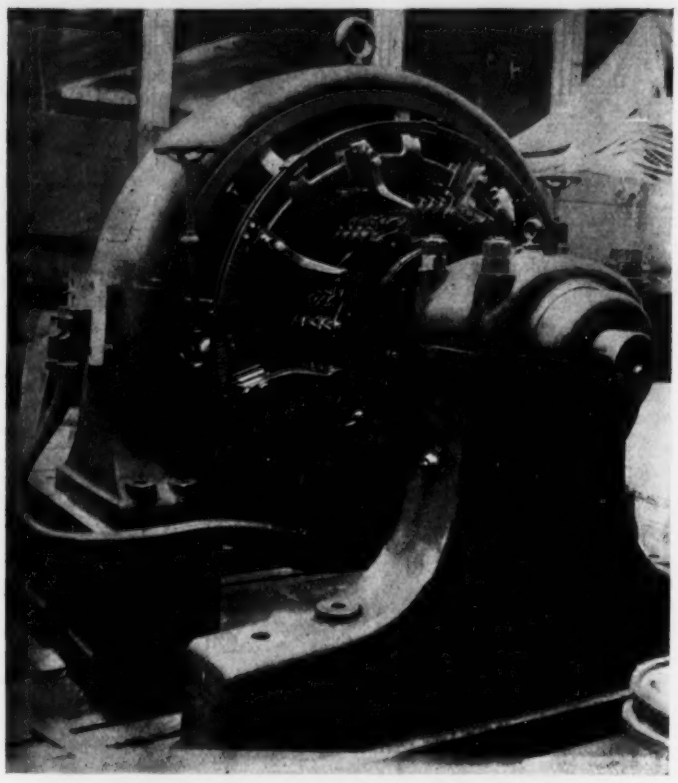


FIG. 7.—100-KW COMPOUND WOUND GENERATOR.

shunt windings according to the conditions of load, the condition of the charge of the storage battery and the regulating effect desired, etc., it is possible to arrange the conditions such that for a certain critical current the battery e. m. f. will exactly equal that at the bus-bars. For a higher current the dynamo will act as a generator to supplement the e. m. f. of the battery, and make it discharge

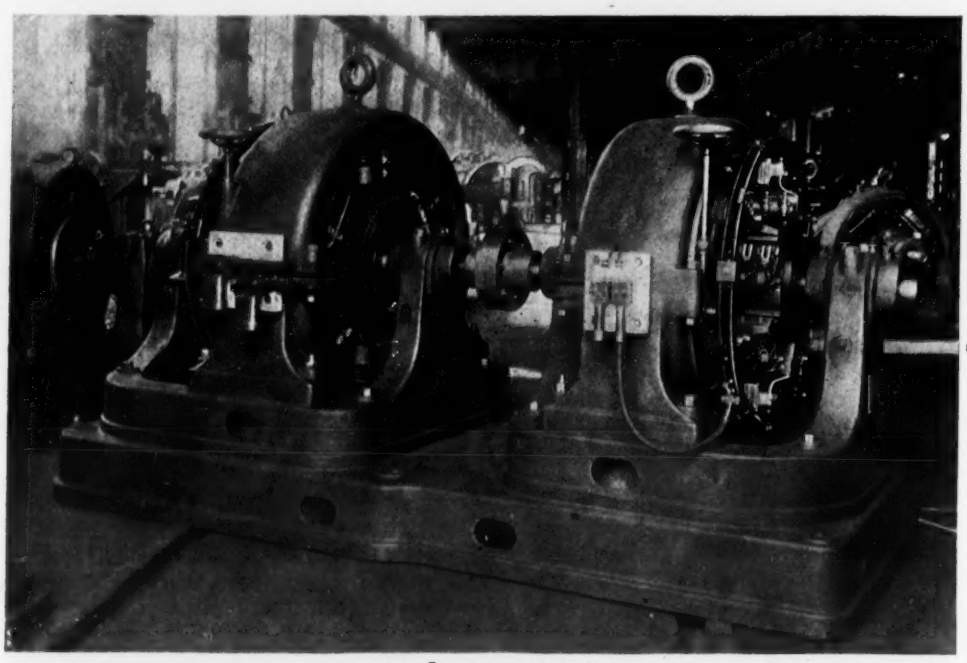


FIG. 8.—20-KW BOOSTER.

in parallel with the generators. If the working current falls below the critical value, the effect of the shunt winding predominates and the booster dynamo will generate an e. m. f. in the opposite direction to supplement the charging effect of the generators, or, what is equivalent to the same thing, to neutralize or reduce the counter e. m. f. of the battery. It is seen, therefore, that when the load increases above the amount for which the adjustments have been made, the booster dynamo will regulate the action of the storage battery so as to make it assist the generators in supplying current, and when the power load becomes light or falls off, the booster will assist the generators in charging the battery.

In practice, the critical current admits of a wide range of regulation according to the load curve, the number of generator units that are in operation, and the condition of the battery, that is to say, whether it is empty or filled, and the rate of charge or discharge which it is desired to maintain. It is the intention to keep the battery filled almost all the time, which can be done by adjusting the relative shunt and series fields. The regulating or compensating action can be obtained with the same ease and precision, when the adjustments are such that the battery takes in more than it gives, or is gaining in charge, as when it gives out more than it takes, or is losing in charge.

The amount of the charging and discharging are shown by recording instruments upon the switchboard, and the station operator is kept advised at all times as to the condition of the storage battery. Current for lighting purposes is taken from the machines beyond the compounding, and the power in connection with the booster and storage battery is taken off within the compounding, by special devices permitting the compounding effect of the battery to be varied.

This method of "ballasting" the circuit was devised many years ago and patented by Mr. C. O. Mailloux, the electrical engineer, who designed the plant, and has been introduced by him in other cases, notably the Astoria Hotel. One application of this method was described by Mr. Mailloux in THE ELECTRICAL ENGINEER of Dec. 3, 1890.

Electrical Papers at the Franklin Institute.

At the last meeting of the season of the Franklin Institute in Philadelphia, on Wednesday, June 21, Mr. T. B. Kinraide, of Jamaica Plain, near Boston, read a short paper on the application of photography to the study of electrical discharges, which included a most interesting and beautiful series of photographs of discharges. The negatives of some of these were shown by means of a lantern which greatly enlarged them, so that they could be examined in detail. Most of them seem to have been made by placing the sensitive plates between the two large spheres which were the terminals of his high frequency, high potential induction coil. Whether the discharges passed over the film side or over the other, was unfortunately not stated, but apparently they were partially conducted by the film. They afforded an opportunity for studying the structure of different kinds of discharges. Many of them were remarkably beautiful. He also showed and operated his form of induction coil, which differed from the usual forms in that the primary was on the outside and the secondary on the inside, the latter being wound as a flat spiral, that is, with a short axis and large diameter. His theories were also explained, but they seem to differ very radically from those usually accepted, and unfortunately there was no opportunity for discussion. He seemed to use the Tesla method of using a high frequency and high voltage secondary current of one induction coil, as the primary current for the second induction coil the discharges of which he then used. While his theories would probably not be generally accepted, his experiments and photographs were exceedingly interesting. It may also be of some interest to note that Mr. Kinraide is the one who after the death of Mr. Keely, of Keely motor fame, agreed to try and make a success of Keely's apparatus. He abandoned it, however, after the exposure of Keely's methods had been made. Mr. W. J. Clark, of New York, exhibited his wireless telegraph apparatus, giving a brief history of its development. Among other things, he made the statement that he had invented a relay which has no self-induction. It was not explained.

General Meeting of the American Institute of Electrical Engineers.

The sixteenth general meeting of the American Institute of Electrical Engineers was convened at Boston at 10:30 a. m., Monday, June 26, in the hall of the Massachusetts Institute of Technology, Mr. A. E. Kennelly presiding. An address of welcome was delivered by Mayor Josiah Quincy, who referred in eloquent terms to the part electricity has played, and the greater part it is destined to play, in the industrial world. In the material progress of the world the invention of the steam engine alone, he said, could be compared in industrial effect to the revolution wrought by the introduction of electric power—a revolution which has not yet reached its culmination and which would eventually still more profoundly modify the relations of man to the conditions of life.

Following the address of Mayor Quincy, the secretary read a number of communications offering various courtesies to the members in attendance on the meeting. The president and fellows of Harvard University extended an invitation to visit the various laboratories of Harvard, stating that professors would be in attendance to receive the members as a body at any time they might signify. The New England Telephone & Telegraph Company and the American Telephone & Telegraph Company (long distance) offered free use of their service to the members during the meeting. The Mayor of Cambridge invited a visit to the Cambridge Manual Training School and the city pumping station, and the Technology Club tendered its hospitality to members, who were also invited to visit the plants of the Boston Terminal Company, Boston Electric Light Company, Boston Edison Illuminating Company, Boston Elevated Railway Company and the Lynn and Schenectady works of the General Electric Company. The presence of members was requested at an informal reception on Wednesday evening at the home of Prof. Elihu Thomson.

The nrst business was the adoption of the report of the Committee on Standardization. This report, which will be later reprinted in our columns, lays down a nomenclature for newer types of electrical apparatus; gives definitions of efficiency with respect to all electrical apparatus in common use; offers standard rules as to rise of temperature and insulation resistance; defines regulation, variation and pulsation with respect to speed of apparatus; gives considerations upon which ratings are to be based, and recommendations as to standard voltages and frequencies, and guarantees as to overload capacity. An appendix contains notes on efficiency of phase-displacing apparatus, apparent efficiency, power and inductance factors, standard notation and sparking distances.

The first paper of the meeting was read by Mr. Charles Proteus Steinmetz on "Symbolic Representation of General Alternating Waves of Double Frequency Vector Products." The paper, which is highly mathematical in form, is an extension of Mr. Steinmetz' system of vector analysis or complex quantities, in order to accurately consider circuits with complex harmonic waves that cannot be properly represented by their equivalent sine waves, such as those including alternating arc, reaction machines, synchronous induction motors, reactances with over-saturated magnetic circuit, high-potential lines in which the maximum difference of potential exceeds the voltage at which brush discharge begins, etc.

To show the application of the equations deduced, a number of problems are solved. In one case of an assumed wave, the formulas determine that the wattless power of the first harmonic is leading, that of the third harmonic zero, and that of the fifth harmonic lagging, while a solution of the equivalent sine wave would have shown a great phase angle displacement whereas 40 amperes of a total of 41.85 are in phase with the e. m. f. Another important consequence deduced is that the resonance effect is, within limits, independent of the magnitude of the higher harmonics, and that therefore the true capacity of a condenser cannot even be approximately determined by measuring volts and amperes if higher harmonics are present, though they be of small amplitude, except by inserting a very large resistance or reactance in series with the condenser. Still another deduction is that higher harmonics in the e. m. f. waves of generators and synchronous motors do not represent a mere waste of current, but may contribute more or less to the output of the motor. Thus, at 75 amperes of total current in a case calculated, the percentage of increase of power due to the high harmonics is equal to the increase of current, or these harmonics do work with the same efficiency as the fundamental wave.

The discussion which followed was participated in by Drs. Hutchinson, Bell and Kennelly, Profs. Thomson, Goldsborough, Ryan, Sheldon and Mathews. All paid a high tribute to the paper as a notable contribution to engineering science. Many phenomena little understood and yet of great practical consequence are doubtless due to the action of harmonics, and the paper offers means for their direct calculation, thus notably advancing the art. Dr. Hutchinson and Prof. Goldsborough referred to the profound manner in which Mr. Steinmetz' system of analysis had modified educational work, and Prof. Thomson spoke of the many anomalies he had met in alternating current working which could now be cleared up by calculation after the method given in the paper.

Mr. Percival Robert Moses next read a paper on "The Cost of Electricity in Some Typical Buildings in New York City," which was frankly an argument for the supply of current by isolated plants instead of from central stations. Data of plants in a number of large buildings were given, showing the cost of operation and including comparisons as to the cost of the same supply of current from central stations, the result being always in favor of the isolated plant. The conclusions of Mr. Moses are that an isolated plant can be operated as a profit at rates lower than those of the central station, even on a widely fluctuating elevator load, and on a light load of short duration; that the isolated plant service is a benefit to both tenant and owner; that through the isolated plant, and only by this means, can the use of electric heating apparatus be brought to its full development; that the central station cannot compete, in so far as cost is concerned, with the isolated plant, where skilled attendance is otherwise required, and steam heat is necessary; that the central station has no mission to fulfil, except that of supplying breakdown service and service to small buildings; that a properly designed plant will, under good management, furnish current in a building of fair size at a cost of from 2 to 4.5 cents per kw-hour.

Messrs. H. Ward Leonard, Williams, Coho, Rice and Steinmetz took part in the discussion which followed. Mr. Williams vigorously opposed the arguments of the paper, and offered figures contradicting many of the claims made as to savings by isolated plants in buildings named in the paper. Instead of 10 per cent. fixed charges, he contended that 18 per cent. is nearer the correct figure; that the value of the space occupied should be considered; that the saving from heating is limited owing to the electric load and demand for heat occurring at different times; that in a central station a man and a boy will look after 2400-kw, while the cost of attendance for a corresponding aggregate capacity of isolated apparatus would be very large. In the course of his remarks Mr. Williams stated that the New York Automobile (Electric Vehicle and Transportation) Company is purchasing central station current for 3 cents per kw-hour.

The final paper on Monday's session was read by Frof. Harris J. Ryan, the title being "Polyphase Electric Testing." The paper described a new method for making instantaneous measurements of alternating currents and e. m. fs. without the use of a contact maker. The apparatus comprises a phase-changer, for which purpose an induction motor may be used; a specially constructed transformer having a core of contracted area such that it will be saturated during 97 per cent. of a period; an open circuit transformer to act as a compensator; and a wattmeter, whose readings under the conditions of the method, will give directly the ordinates of the desired curve of variation of current or e. m. f. Besides the simplicity of the apparatus, the method has the advantage of giving values which correspond to very small elements of time—in a case cited, 1-6000 part of a second for each value registered—thus being more accurate than the contact method.

In the discussion following, Mr. Steinmetz spoke in high terms of the method described, which he considered much superior to any contact method, and beautiful in principle. He also sketched another method for obtaining data for similar curves, which also does not depend on contacts, and employs a condenser, which is charged at the potentials corresponding to the various points of the curves, these potentials being measured on discharge. Prof. Mathews referred to a method devised by Prof. Hotchkiss for the same purpose; an account of this method will be given in these columns in an early issue. Prof. Sheldon brought up the subject of the aluminum cell or "electric valve," which is used in Prof. Ryan's method. Mr. Steinmetz stated that its action in suppressing half of an alternating current was due to an aluminum oxide which formed on the plates, and that up to 15 volts its action was absolute in refusing passage to the current of sign opposite to that passing. This property, he said, had been employed by Mr. Edward Holden as long as four years ago.

Electrical Notes in China—III.

By Prof. F. B. Crocker.

ELECTRIC power and electric railways in China can be described almost as briefly as snakes in Ireland, but this negative condition of affairs is likely to be changed very greatly in the immediate future. In Shanghai detailed plans had already been prepared for an electric road when I was there in January, and doubtless by this time it is under construction. It was to be built and operated by the municipality, as already explained in the case of the electric lighting system which they have in that city.

The opposition to the "deadly trolley" existed there the same as in other places. The inhabitants of each town, wherever it may be and whenever it may adopt electric railways, always talk as if they were the only people in the world who had ever thought of attempting such a dangerous experiment. In point of fact, the problem is somewhat complicated in Oriental cities by narrow and crowded streets, as I have stated in reference to Japan. But in the latter country there are several places operating electric railways where the streets are much the same as in other Japanese or Chinese towns. In some way or other the electric roads seem to be able to find a place for themselves, and after they have once taken possession of a street, they very, very rarely vacate it in spite of injunctions and the grumblings of the people who really would not, if they could, get along without the much-abused electric cars. Life is such a very cheap commodity among Chinamen that a few victims of the trolley would never be missed and their fate, however uncomfortable individually, would not be regarded as a sufficient reason for doing away with the new means of locomotion. Such is the case in the most civilized countries and it is a still less serious matter in uncivilized ones.

After one has seen the reckless manner in which "automobiles" and other vehicles dash through the streets of Paris he realizes that the raison d'etre of the foot passenger is to serve as a moving target for them. Rapid transit on sea as well as land is the chief object of material progress at the present time. Formerly "might made right," now "speed makes right." Automobiles often run at more than twenty miles an hour in the streets of Paris, and over thirty miles per hour in the suburbs. They do this not only when the way is wide and clear, but also on narrow roads in which there are many other vehicles, and pedestrians passing across. Of course, there is no good reason for going at such a breakneck rate as this. In the majority of cases they are riding for pleasure—not that of the people in their way. In Paris they arrest and fine the person who is run over! The conclusion to be derived from these facts is the necessity for high speeds on steamers, railways, street cars and other vehicles simply because it is demanded by the general public in spite of danger to the individual. Electric cars already run through the narrow streets of Eastern cities teeming with inhabitants, and many more lines will be laid and cars added every year. It is inevitable, and will be an important factor in civilizing those countries.

The Oriental loves to travel. This is shown in the pilgrimage of the Mahometans and Hindus. The numbers of native passeners on Indian and Japanese (steam) railways are very much greater than was expected, and consequently these roads generally pay well. It is a striking sight to see the crowds of natives that get on and off the trains at almost every station. Business can not be the principal reason for this travel, since many of the passengers are of the very poorest class, whose affairs are not likely to extend outside of their own villages. It must be largely the natural desire to see places and people away from home. The same inclination is exhibited by the large number of persons, mostly natives, who patronize street cars and other conveyances in Oriental towns. In China and Japan the majority of persons riding in jinrikshas appear to be as poor as or even poorer than the men who drag them about. In my opinion electric railways have an enormous field in almost all Oriental countries—the usual warm climate, the indolence of the people and their desire to travel combine to make the conditions very favorable. The steam tramways with "dummy" engines which have been introduced widely in India and Burmah are thoroughly unsuited to the circumstances. They are as clumsy and unattractive to ride upon as a steam roller. The coolness and the controllability in crowded thoroughfares of the electric car will certainly make it very popular in Oriental cities; this applies also to electric carriages or other vehicles.

Stationary electric motors are very few in China, chiefly because there are no supply circuits operated during the day. In any country it seems to have been necessary for electric lighting to be well established and used to such an extent that day circuits were demanded before motors could be generally introduced. This is not a necessary sequence; in some instances it has been reversed, where energy is generated in hydraulic plants and distributed primarily for running motors and afterwards incidentally to supply lights. The water power of China has not been developed more than other factors of modern civilization. There are several schemes of the kind that are already being pushed forward even in the interior of the country, some in connection with mining enterprises. There are great opportunities in the latter direction, the mineral resources being enormous and the present operations being on a small scale with very primitive methods.

The utilization of electric motors for ventilation and for manufacturing purposes is very limited on account of there being no day circuits, as already stated, and also because of the extreme cheapness of labor. But in my previous letters on Japan, it was shown that electric power compared very favorably with manual labor even when the latter cost only 10 or 15 cents a day, which is about the price for unskilled work in those countries. But of course very cheap labor does greatly retard the introduction of motors. When one sees silk fabrics woven, rice polished and other operations of that kind performed by hand or foot power, one realizes how much difference is made by low-priced labor. But when I sighted a large

EXAMINATION HALLS, CANTON.

paddle-wheel ferryboat carrying forty or fifty persons and "energized" by a dozen men in a sort of treadmill, it was hardly possible to believe my eyes. In the river at Canton there are many such craft, so I had to accept them as real. They make fairly good headway even against the current of the river and appear to go four or five miles an hour. It is difficult to understand how this speed is possible when we consider the great amount of steam or electric power required to propel boats. It is similar to the fact that it now takes two motors of thirty or more horse-power each for a street car when formerly it required only two horses. Another example forcibly illustrating cheap labor methods: Men and women carrying bricks and sand in baskets up to the top of the "Peak" at Hong Kong, about a thousand feet high, there being a cable railway operated by steam running all the way. It seems like competing with the railways by carrying coal from Pennsylvania to New York on a bicycle. By the way, the Chinese consider the driving of a large ferryboat or the carrying of sand up a thousand feet, by man power, far more sensible than our riding bicycles for pleasure, because the Chinamen are paid to work and must earn a living, whereas we get nothing for our labor.

Electrical manufacturing in China is entirely undeveloped and is likely to remain so for some time to come. The Chinese are good workmen in other lines and would undoubtedly be able to do well in making electrical apparatus, but as yet there is very little demand for it, and even when that increases the supply will be imported for many years. A great deal of it should be sent from the United States, provided the "open door" is not allowed to be closed. The Chinese question is one to which Americans have paid little heed; nevertheless, it is almost as important to them as it is to the English, who have long given it the closest attention, even though their policy is sometimes lacking in strength. Now, that our eyes are turned in that direction, we shall learn more of this question and appreciate its importance. That is the chief reason why England

is favorable to our possession of the Philippines. All the Englishmen in the Far East speak strongly in that vein. We do not desire any territory in China. We have as much as we want but not more than we can handle in the Philippines, which are only a very few hundred miles away; but we do want trade with China—the more the better. The American electrical manufacturer would not suffer so very much from Russian absorption of Chinese territory, because they now import a great deal of their electrical supplies from the United States for Vladivostock, Port Arthur and other Russian possessions in that vicinity. From that point of view it might be better to have China devoured by Russia, rather than by Germany, France or even England.

Electrical education in China, like most of the other electrical matters there, does not exist, but unlike them, it is not likely to be developed for many years to come. It is already well advanced in Japan, because that country is very progressive, while China is about as much so as a dead turtle. To be sure, the general educational system of China is extremely elaborate, but it remains the same as it has been for centuries. The Chinese "Book of Rites," dating from 1200 B. C., which is thirty-one hundred years ago, says: "For the purpose of education among the ancients, villages had their schools, districts their academies, departments their colleges and principalities their universities." This system is as complete as anything to-day even in Germany, and antedates by two thousand years the oldest universities of Europe. But little progress has been made since that time. It is still almost confined to Chinese classics (Confucius and other early writers) and history. Mathematics and science are not taught, and the history, geography and other facts concerning any nation but China are unheard of. Beyond the ordinary education there are three degrees which are given to those who successfully pass advanced examinations.

The "Pumping" of Rotary Converters.

In the current number of the Bulletin of the Association des Ingenieurs Electriciens sortis de l'Institut Electrotechnique Montefiore, Signor Cesare Pio has an article on the rotary converter as applied to electric traction, in which this type of apparatus is thoroughly described and information given concerning its use in connection with several American street railway systems. Several pages are devoted to the subject of "pumping" of rotary converters, of which the following is a translation.

When rotary converters are worked in parallel their proper operation is at times subject to interference by the action of "pumping," which is due to certain armature actions not yet well understood. Each variation of alternating voltage produces a persistent pulsation in the direct-current voltage. When pumping has once begun, the field may be regulated in vain without stopping the pulsations. The number of pulsations is sometimes 70 per minute and their amplitude may attain 30 or 40 volts. This phenomenon takes place at all loads. A tachymeter on the end of the rotary converter shaft will indicate variations of speed above and below the synchronous speed corresponding to the variations of voltage. If a piece of iron is approached to the field it can be felt to vibrate in the hand, which clearly proves alternations in the strength of the field.

The General Electric Company has given serious attention to this effect and has devised means to eliminate. First, instead of the ordinary cast polar projections, laminated poles were substituted, but this change produced no result. Next, the brushes of the commutator were so disposed as to short circuit several sections of the armature, but without effect. Some months ago Mr. Charles P. Steinmetz tried the expedient of bridging the several polar projections with sheets of copper ¼ of an inch in thickness. The effect of the eddy currents induced in these bridges made the field uniform and entirely eliminated hunting.

The four three-phase converters of the Central London Railway were fitted with these copper bridges, and during trials there was no evidence of hunting. The same converters when first tried and before they were fitted with copper bridges were subject to extreme oscillations of voltage. The copper bridges, as may be surmised, heat considerably, but not to a serious extent when there is strong ventilation from the armature. As to the efficiency, this is not lessened more than 1½ per cent. by the employment of the bridges.

Signor Pio had occasion to see for himself the good effect produced by bridges fitted between the polar projections. Two three-phase converters of 300-kw each which were built for traction service, were supplied from the same alternator, the voltage being reduced by means of three transformers connected in star, giving 300 volts at the collector rings. Without load when synchronous speed was reached, a Weston voltmeter indicated at the two commutators an e. m. f. of 500, but as soon as the switch was closed and a non-inductive resistance added to the circuit which produced in it a drop of 5 per cent., equal to what the machine would experience in actual service, pumping commenced, and the needle of the voltmeter oscillated continuously and indicated variations of 35 volts, positive and negative. The excitation of the alternators was then raised to bring up the voltage to the original value, but it was not possible to stop the pumping. The fields of the two rotaries were varied within a large range and to a point when 1000 amperes flowed in the armature; beyond that point the rotaries stopped on account of lack of capacity of the alternators, but the pumping continued until the last moment. After some days, the same machines fitted with copper bridges gave very satisfactory results.

Underground Electrical Construction.*—II.

The following table gives what is now approximately the standard practice regarding thickness of insulation and lead wall, for both paper and rubber covered cables for central station work employing 500 volts and under:

RUBBER CABLE.

Size.	Strands.	Wall.	Lead.
250,000	19	3-32	1-16
350,000	37	7-64	5-64
500,000	61	4-32	3-32
750,000	61	9-64	3-32
1,000,000	61	9-64	3-32
1,500,000	91	11-64	1-8

PAPER CABLE.

Size.	Strands.	Wall.	Lead.
250,000	19	4-32	1-8
350,000	37	5-32	1-8
500,000	61	5-32	1-8
750,000	61	5-32	1-8
1,000,000	61	5-32	1-8
1,500,000	91	6-32	1-8

The first companies to use conduit in this country were those operating high tension series arc and alternating current systems. Among the first conduits to be used was the old Dorsett conduit, made up in multiple ducts, and laid directly in the ground. These ducts never proved successful and were later replaced by pump log ducts, which, though very cheap, were found to deteriorate rapidly and gave a great deal of trouble by catching on fire when a burn-out took place in the cable. This conduit has given way to fireproof ducts made of cement, vitrified clay tile and iron ducts with cement lining.

The table on the next page shows the costs per duct foot of various types of conduit laid in various types of pavements, the figures being computed upon a uniform price of 10½ cents per lineal duct foot for ditching and laying of conduit, including cement concrete.

The cost of ditching and repaving will vary in different cities, according to the class of soil and according to the method employed by the city in letting contracts for the maintenance of the pavements.

The cost of repavement for cedar is (per square yard)	$ .45
Cedar reserve is (per square yard)	.75
Granite is (per square yard)	.75
Granite reserve is (per square yard)	1.50
Macadam is (per square yard)	.35
Asphalt is (per square yard)	3.00

The system of underground distribution now almost universally adopted by large central station companies employs cables drawn into ducts for the feeders and Edison tube for the mains. The conduit consists of from six to thirty or more ducts laid in cement concrete, the top tier being about two feet below the top surface of the pavement. At each street intersection the conduit system enters a manhole which is built up of a nine-inch brick wall, the dimensions of the manholes varying according to the number of ducts and the importance of its location .

The roof of the manhole is built up of steel beams, with brick arches, cast iron frame being laid in the pavement to provide for supporting the manhole cover, which is punctured with circular openings to admit of the exit of gas and entrance of air. The bottom of the manhole is concrete and is connected to the sewerage system of the city, backwater traps being provided to prevent the backing up of sewage into the manhole. The conduit system with its manholes

*Abstract of paper read by Mr. L. A. Ferguson at the recent convention of the National Electric Light Association.

thus constructed forms a part of the sewerage system of the city and any water which enters the manholes from the street drains off to the sewer, and free circulation of air from one manhole to another is obtained through the ducts.

TOTAL COST OF CONDUIT LAID PER DUCT FOOT IN DIFFERENT GROUPS.

Kind of Pavement.	Groups of 2 or 4.	Groups of 6 or 9.	Groups of 12, 16 or 20.	Groups of 25 or 30.	Groups of 40, 50 or 60.
National Conduit.					
No pavement..	16.74 cts.	16.74 cts.	16.74 cts.	16.74 cts.	16.74 cts.
Cedar	22.81	19.27	18.07	17.56	17.31
Cedar reserve..	26.86	20.95	18.94	18.11	17 69
Granite	26.86	20.95	18.94	18.11	17.69
Granite reserve	36.99	25.17	21.14	19.49	18.64
Macadam	21.46	18.70	17.77	17.38	17.18
Asphalt	57.24	33.61	25.55	22.24	20.56
Francis Conduit.					
No pavement..	14.66 cts.	14.66 cts.	14.66 cts.	14.66 cts.	14.66 cts.
Cedar	20.73	17.19	15.99	15.48	15.23
Cedar reserve..	24.78	18.87	16.86	16.03	15.61
Granite	24.78	18.87	16.86	16.03	15.61
Granite reserve	34.91	23.09	19.06	17.41	16.56
Macadam	19.38	16.62	15.69	15.30	15.10
Asphalt	55.16	31.53	23.47	20.16	18.48
Camp Tile.					
No pavement..	14.14 cts.	14.14 cts.	14.14 cts.	14.14 cts.	14.14 cts.
Cedar	20.21	16.67	15.47	14.96	14.71
Cedar reserve..	24.26	18.35	16.34	15.51	15.09
Granite	24.26	18.35	16.34	15.51	15.09
Granite reserve	34.39	22.57	18.54	16.89	16.04
Macadam	18.86	16.10	15.17	14.78	14.53
Asphalt	54.64	31.01	22.95	19.64	15.96
Lithocite Conduit.					
No pavement..	15.18 cts.	15.18 cts.	15.18 cts.	15.18 cts.	15.18 cts.
Cedar	21.25	17.71	16.51	16.00	15.75
Cedar reserve..	25.30	19.39	17.38	16.55	16.13
Granite	25.30	19.39	17.38	16.55	16.13
Granite reserve	35.43	23.61	19.58	17.93	17.08
Macadam	19.90	17.14	16.21	15.82	15.62
Asphalt	55.68	32.05	23.99	20.68	19.00
Three-Inch Iron Pipe.					
No pavement..	25.5 cts.	25.5 cts.	25.5 cts.	25.5 cts.	25.5 cts.
Cedar	31.57	28.03	26.83	26.32	26.07
Cedar reserve..	35.62	29.71	27.70	26.87	26.45
Granite	35.62	29.71	27.70	26.87	26.45
Granite reserve	45.75	33.93	29.90	28.25	27.40
Macadam	30.22	27.46	26.53	26.14	25.94
Asphalt	66.00	42.37	34.31	31.00	29.32

In these manholes are placed junction boxes in which the cable feeders terminate. Edison tube mains project through the wall of the manhole and their ends are connected by means of cables to the terminals in the junction boxes, connections between terminals and the bus bars of the junction boxes being made by copper safety catches.

All feeder cables are drawn in in lengths of from 400 to 600 feet, and are connected in the manhole by means of feeder coupling boxes. The latter are made of iron, with hinged cover with bushel entrance for the cables, termina's inside being connected together by means of copper bar links. The following table shows the cost of construction of manholes of various dimensions in different types of pavement:

TOTAL COST OF DIFFERENT SIZES OF MANHOLES INCLUSIVE OF COST OF REPAVEMENT OF VARIOUS KINDS.

Kind of Pavement.	2'x3'x3'	3'x3'x4'	3'x4'x4'	4'x4'x4'	4'x5'x5'
Cedar	$32.18	$42.52	$49.21	$55.45	$67.05
Cedar Reserve.....	32.94	43.46	50.32	56.78	68.58
Granite	32.94	43.46	50.32	56.78	68.58
Granite Reserve.....	34.83	45.80	53.10	60.08	72.44
Macadam	31.92	42.21	48.84	55.01	66.54
Asphalt	38.63	50.48	58.67	66.70	80.08
Kind of Pavement.	**5'x5'x5'**	**6'x6'x6'**	**6'x7'x6'**	**7'x7'x7'**	**8'x8'x8'**
Cedar	$111.67	$136.57	$146.62	$164.38	$194.65
Cedar Reserve.....	113.50	138.87	149.19	167.27	198.19
Granite	113.50	138.87	149.19	167.27	198.19
Granite Reserve.....	117.94	144.60	155.63	174.47	207.03
Macadam	111.13	135.81	145.76	163.42	193.48
Asphalt	126.82	156.08	168.50	188.89	224.72

In conduit systems one of the greatest difficulties experienced is with gas which leaks into the manholes, sometimes from the sewer, but generally from the illuminating gas pipes which have been laid for years in the streets in our large cities, and I am informed that in New York City the leakage is so great that explosions are avoided and conduit manholes rendered accessible only by maintaining a pressure slightly in excess of the atmospheric pressure throughout the conduit system. This is accomplished by compressing stations, which are maintained at a large expense and which are indispensable, since no natural system of ventilation would be sufficient. In other cities, such as Chicago, where the leakage is by no means as great as in New York, the manholes are constructed, as I have before described, connected with the sewer system of the city, and a natural means of ventilation is employed.

The manhole covers are perforated and a slight pitch is given to the duct line between manholes, and explosions are of very rare occurrence. In winter time, however, it is necessary to keep the manhole covers free from frozen snow, as the latter prevents ventilation and allows the formation of gas in the manholes, which may produce an explosion from short circuits or other causes.

A conduit system, which might be termed a compromise between the Edison tube and the ordinary conduit system, is one which has been used to some extent in this country and is known as the Cummings duct. This duct consists of iron pipe in which is placed a wooden duct made with any number of openings, the pipe being coupled in much the same manner as is done in the Edison tube mains. Bare copper cables are drawn through these ducts and are connected in a junction box similar to that of the ordinary Edison tube system.

All large American cities are crossed and recrossed by trolley lines, supplied from numerous power stations and fed in a manner similar to the network of a lighting system. The introduction of the current from these railway companies has been a matter of important consideration to the lighting companies, since with poor rail construction and insufficient return feeders part of the current returns from certain sections of the system along the lighting cable sheaths, gas and water pipes, causing serious trouble at the points where the railway current leaves the conducting devices of other corporations.

The use of jute for covering lead cables is almost universal in Europe owing to the fact that it has been the practice there to lay cables directly in the ground, whereas, in America almost all underground work has been done with the use of conduit, and jute has been employed only to a limited extent. There are very few cable manufacturers in this country who are thoroughly acquainted with the art of applying jute to lead-covered cables, and on this account the value of jute covering has not been appreciated. Unless the jute is served with the greatest of care and in the proper manner it is entirely useless, since when it is drawn into the duct it is often exceedingly difficult to remove the cable in case of trouble.

Jute is of no value as a preventative of electrolysis in a wet duct, since it ceases to insulate the lead sheath from the stray current of the railway circuits. Another disadvantage in the use of jute cables where duct systems are used is the additional duct space which is required owing to the increased diameter of the cable, and where more than one jute cable is drawn into the same duct it is often difficult to remove either cable afterward in case trouble has developed.

The use of paper instead of rubber insulation for cable is almost universal in Europe and has become more and more prevalent in this country, and with the present relative market value of paper and rubber, paper cables have a very decided advantage over rubber cables, and experience has shown that paper cables may be relied upon to give satisfaction, provided proper care is exercised in the handling of the cable, the installation skilfully made and the lead sheathing, which is indirectly the real insulation of the cable, is preserved.

In crossing rivers and bays it is necessary to use cables, and in these cases cable of the submarine type is used. This cable is insulated with either paper or rubber, and is lead covered, juted and asphalted and protected with either a steel band iron armor or armor consisting of strands of iron wires.

In the case of shallow rivers the river bed is dredged to a depth of about six feet, and a diver is sent down from a small row boat to lay the cable in the trough in the bed of the river. Where large numbers of cables are to be used to cross rivers or bays, tunnels are sometimes built. The Chicago Edison Company's tunnel across the Chicago River has a shaft 60 feet deep, the tunnel being large enough for a man to walk comfortably through. Iron racks on either side of the tunnel support 68 submarine cables of 1,000,000 circ. mils each.

While there is the greatest temptation on the part of the central station manager, on account of the less amount of investment required, to erect wherever possible overhead lines, it is very questionable whether this is the wisest and most conservative policy to follow. The use of underground construction should be most strongly recommended wherever the return on the investment will permit. The experience of time has shown that in large cities the wires, at least in the business district, must eventually be put underground, and those companies that originally started with an underground system have proven the wisdom of their course.

There are many distinctive advantages to be gained in the use of underground system—the great freedom from danger to apparatus from lightning and the uninterrupted service in heavy snow and wind storms, and the reduction of the danger to the lives of employees and public, together with the stability of the investment and the freedom from objection on the part of property-owners and municipal authorities. All of these advantages are most worthy of consideration and should weigh heavily as against the apparent saving to be effected in the first investment cost of the lighting company.

In the discussion of Mr. Ferguson's paper, Mr. Stetson stated that in New Bedford the municipal government is now proposing to put down a conduit system and to carry therein the conductors of the several electrical interests. He said he believed Philadelphia is the only city which has experimented along that line, and from the testimony of the city electricians the results were satisfactory.

Mr. Gille said that his company has an extensive underground Edison system in St. Paul, but much trouble is experienced from electrolysis. When the street railway company in St. Paul first changed to the electric system, it was in the habit of bonding to the underground electrical tubing. This practice has been discontinued.

Mr. Barstow said that trouble from electrolysis is experienced in Brooklyn, but that the railway companies have finally come to the conclusion that it will pay them better in the end to bond their rails and thus get a better return circuit, than to pay for the renewal of tubes and cables.

The Brooklyn Electrical Supply System for Lighting and Power*—I.

GENERATION AND OPERATION.

Brooklyn, some fifty years ago, included three square miles of territory, of which the present Brooklyn Bridge terminal was the centre. To the north grew up the smaller towns of Williamsburg and Greenpoint; to the east, the settlement of East New York, and to the south, the towns of Canarsie, Flatbush, Gravesend, Bensonhurst, New Utrecht and Bay Ridge. Each town had its own little business centre, its own town hall and, in several cases, its own banks, theatres, etc. About forty years ago the limits of the city of Brooklyn were extended to include Williamsburg, the city then covering some 16 square miles, in which there were located two distinct commercial centres, about two miles apart, and separated by farm lands and unsettled country. About six years ago the boundaries of the city were extended to take in all Kings County towns, thus covering some 120 square miles of territory. The lighting companies in Brooklyn in those days were four in number, but a gradual consolidation soon placed one company in possession of all the territorial rights—overhead and underground—of the city, which now covers about 120 square miles.

In 1895 the Edison Company decided to occupy at once with distributing systems of some kind all the best portions of the territory of the greater city, so as to preoccupy the field against any newcomer. This meant, on account of the scattered centres composing the enlarged city, due to the amalgamation of the different towns, either the establishing of eight small steam stations or the installation of some system that could furnish energy for any class of distributing system which might be installed in any of the localities, at the same time rendering more efficient the existing plants. Under these conditions there was no hesitation in at once outlining a plan which would provide for a large and independently located transmission distributing system.

The plan as originally outlined in 1896, and as finally completed in 1897, provided for the use of a three-phase, 25-cycle, 6600-volt system, three-phase because its use was for transmission purposes only; 25-cycle, because of the ease at this frequency of station operation, transmission and transformation; and a pressure of 6600 volts because this was sufficient, with the price of copper at 18 cents, to reach economically all parts of the greater city and suburbs; should it in the future ever become necessary to extend beyond this 12-mile limit, the pressure could be increased by transformers placed out at the city lines for overhead transmission to other territory.

The main station, located on the water front at Bay Ridge, is called the Union Station, because it generates a current which unites all systems hitherto separately operated. From this point high-tension feeders, the majority under ground, extend to ten substations, where the energy is received, transformed and distributed as follows:

Substation "A" distributes energy for 1700 high-tension, direct-current, series arc lamps on an overhead system.

Substation "B," as well as substation "C," distributes two-phase, 60-cycle currents, up to a capacity of 200-kw, to an overhead system.

Substation "D" distributes two-phase, 60-cycle, alternating currents of about 200-kw capacity to an underground distributing system. This underground system is composed of Edison three-wire tube, with block transformers in manholes.

Substation "E" distributes high-tension direct current for 300 series arc lamps, low-tension direct current on three-wire system to a capacity of 800-kw, and high-tension alternating currents, two-phase, 60-cycle, of a capacity of 200-kw, to overhead distributing systems.

Substation "F" distributes 400-kw of direct current to an underground Edison three-wire system.

Substation "G" distributes 200-kw of direct current to an Edison overhead system.

Substation "H" distributes 200-kw of direct current to an Edison overhead system, besides 250-kw to 500-volt power system along water front.

The First District substation distributes 800-kw of direct current to an Edison underground system.

The Second District substation distributes 400-kw of direct current to an Edison underground system.

The Third District substation distributes 400-kw of direct current to an Edison underground system.

The municipal substation, when transformed and completed, will distribute energy for 1700 direct-current series arcs and will have 500-kw capacity of three-phase, 60-cycle, alternating currents.

When it is appreciated that this entire number of substations, each supplying a territory about one and one-half miles in diameter and covering an area of 120 square miles, is supplied by one station, and often from one large generator, the simplicity of the generating system can be easily seen.

The Firs. and Third District substations are what may be termed "peak" plants, the original steam plants being still used during the "peak" hours, thus leaving on the main station a load that is practically uniform during the twenty-four hours; in fact, possessing a load-factor, six days per week, of over 90 per cent.

Such a generating and distributing system possesses not only great engineering advantages, but is a means whereby the highest load-factor can be secured. Several stations operating distinctly non-interchangeable systems can never reach the minimum cost in the production of energy. One station operating a universal system, or even two stations operating universal interchangeable systems, at once have at their disposal means for developing economies.

During the operating of the three-phase system in Brooklyn, admirable chance has been given for testing the practical value of the load-factor. At one time 2000-hp was shifted to and from the Union station from two of the large direct-current stations in such a way for each of two days the total generated kilowatts of the Union Station remained exactly the same; but the load-factor during one of the days was 25 per cent. and during the other 80 per cent. Careful record was then kept of the cost of generation during the 24 hours of these two days in the Union station. It was found that when the load-factor of the station was 80 per cent. the cost was decreased 70 per cent. over what it was when the load-factor was 25 per cent., the total kilowatt-hours of each of the two days being exactly the same.

With a view of keeping continuous records of the detail performance of the system, a complete line of recording wattmeters was provided for. At the Union station, each generator output is metered; all energy is metered used in the station, comprising energy supplied to pumps, blowers and auxiliaries to steam plant, which are all electric; all energy supplied to the generator fields, used in station lighting, in coal handling, operation of crane, etc., is also metered. It was found unnecessary to put wattmeters on both ends of the feeders leaving the Union station and leading to substations, with the object of ascertaining the loss in transmission, because the loss in transmission is often not more than the error in the meter itself; *i. e.*, two or three per cent. Taking the energy used in the station from the energy generated at the machine gives the energy delivered to the feeders. This energy is metered to the different substations. Each substation output is metered in whatever form the energy is distributed to the customer. This last set of readings, plus the aver-

*Abstract of a paper read by Mr. W. S. Barstow at the recent Convention of the National Electric Light Association.

age loss of each substation distributing system, is designated "current sold to the customer," and upon this reading is based all the cost of distributed energy. Thus, it can be seen that the energy, from the point of generation to the point of entering the customer's meter, can be kept trace of, step by step, and the commercial efficiency of each substation easily determined.

As a result of investigations the Union station was designed and equipped with all auxiliaries electrically operated, the steam from the boilers being used only in the main engines. There is often brought forward the question as to whether the loss in feed-water temperature, etc., will not more than balance the high efficiency of the electric auxiliary. Under ideal conditions all heat units of the exhaust of the auxiliary could be recovered, and such a system would be perfection. In the ordinary central station we find that the radiation of supply piping and the pumps themselves involve a loss of 25 per cent., and that the pumps require more steam than can be condensed in the feed-water heater under different conditions of load, thereby allowing surplus steam or heat units to escape to the atmosphere. Also, it is impractical in the majority of cases to return to the boiler the steam condensed by the feed-water, owing to the presence of oil, and the methods of separating the oil from such water are naturally slow and in themselves involve a loss of heat or expenditure of energy. Thus the entire problem becomes one of actual practice rather than theory.

With electric auxiliaries driven from the main engine, or auxiliaries connected with the main engine, the economy of the auxiliary is very nearly the economy of the main engine itself. In other words, the electric auxiliary can develop a horse-power on the shaft of the pump with about 18 pounds of steam, including losses. This is about one-fifth of the energy required by a steam auxiliary best suited to the conditions. But, on the other hand, the electric auxiliary returns no energy back to the plant, and a certain allowance must be made for the loss in feed-water temperature. In considering the two systems in an individual plant, comparison should be made both with systems using economizers and exhaust heaters, one using supplementary heater with steam auxiliaries and the other electric auxiliaries without supplementary heater. In many cases the highest efficiency can, no doubt, be secured by using a few steam auxiliaries that would furnish just sufficient steam to be condensed in the supplemenary heater, varying the use of the steam auxiliaries with the load.

The actual energy required by the electric auxiliaries at the Union station, with a load of 2732 indicated horse power on the main engine, is as follows:

	Electric horse power.		Per cent.
Air pumps on surface condensers	11.6	or	.42
Circulating pumps on surface condensers	14.4	"	.53
Boiler feed-pumps	23.6	"	.87
Total of main auxiliaries	49.6		1.82

Reducing this to indicated horse power at main engine, 66.8 indicated horse power, or 2.45 per cent. of the total steam used in the station.

In addition to reducing to a minimum the energy required by the station auxiliaries under ordinary conditions, the building was so constructed as to reduce to a considerable extent the amount of work from the auxiliaries. This applied particularly to the method of circulating the water for the surface condensers. Two large tunnels, each twelve feet high and eight feet wide, were constructed, side by side, beneath the entire foundations of the building, with their openings below the mean tide level and extending out into the bay. These tunnels, constructed of heavy masonry and extending directly beneath the large surface condensers, are always filled with water, which rises and falls in both tunnels equally, according to the tide of the bay. The circulating water is taken from one tunnel by a direct-connected electric centrifugal pump, passed through the surface condenser and discharged into the other tunnel, the discharge pipe extending below the lowest water level. This construction forms a water loop in which both legs are of equal length, and in which loop are located centrifugal pump and surface condenser. Thus, when the water is once started, the columns balance one another, so that very little power is required by the centrifugal pumps. In order to prevent an air pocket from forming and breaking at intervals the discharge column, an air pipe connection is carried from the top of the discharge opening in the condenser to the air pump, a very slight turn of the valve sufficing to keep all of the air out of the system. Whereas, under ordinary conditions, about 26-hp would be required, under these new conditions but 7-hp is necessary to circulate water sufficient for furnishing 26 inches of vacuum to 1500-hp.

Among the auxiliaries might be classed the generator field exciters. The question of economically exciting the fields of large alternators has been one which has often been overlooked to a large extent as a matter of small importance. After carefully studying the subject, the following plan was adopted in the Brooklyn installation:

A high-tension, synchronous motor, directly connected to a low-tension, direct-current generator, is directly connected to the bus bars of the station, to which are connected the main alternators. The low-tension, direct-current generator, connected in multiple with a small regulating storage battery, excites the fields. Should the voltage on the main system vary to a greater or less extent, no variation occurs in the voltage of the field excitation, since the synchronous motor, which depends for its speed on the speed of the main generator, and not on the voltage, supplies power to the direct-current exciter. Should the speed of the engine vary to any extent, the battery acts as a regulator. The battery also is of such a capacity that the entire exciting set can be shut down for one hour without any variation in the exciting voltage, the battery automatically discharging. If, in place of a synchronous motor set, a rotary transformer were used, the result would be somewhat unsatisfactory, since a variation in voltage, as well as speed on the main generator, would affect the field current. Of course, belted or direct-connected exciters can be used with the battery with equally good economical results, but independently operated exciters furnish a more flexible system.

In the designing of a switchboard for high-pressure work special attention should be paid to the simplicity of arrangement and contents of such board, as the fewer the devices, the better for the reliability and success of the system. The conditions of the operation of a high-tension polyphase system, when used for distributing purposes to substations, differ considerably from the requirements of a primary station with a simple distributing system. This difference lies mainly in the fact that feeder regulation in the high-tension polyphase transmission system can be almost entirely dispensed with, the substations doing the necessary regulating for the energy as required by the customers. Therefore, the important requirement in the polyphase transmission station becomes simply the positive controlling of the energy generated at the machines, with possibly the operating of one or two sets of auxiliary bus-bars. For the controlling of this generated energy, switches, capable of breaking a full and overload current, should be placed between the generators and the bus-bars, and between each set of bus-bars. This requirement will be found to be imperative.

In Brooklyn these switches are operated by the type of electrically controlled pneumatic attachment used by the Pennsylvania Railroad system in its large switch yards. In all cases these have been positive and satisfactory in action. It is the present intention to control the interlocking circuit by a device dependent upon the synchronizing of the current, so that two machines or sets of bus-bars cannot in any way be accidentally connected when out of phase. The switch itself, breaking under oil, is not in any way complicated, and has satisfactorily withstood the test of capacity and time. These main switches, placed as above stated, are the only ones in the station which will break under overload and pressure of 7000 volts, with the exception of the emergency switches. These emergency switches are plain pivoted copper blades, with a fuse in multiple, and are to be pulled only in a case of last resort in event of any accident happening to the switchboard itself. As before stated, the controlling of the feeder load from the transmitting station is not an actual requirement in the polyphase system with substations, as the load can more easily be controlled at the substation, and therefore the high tension-feeder switch can consist of a simple pivoted copper blade placed between the bus-bars and fuse block.

The running of large alternators in multiple has always proved an attractive subject. The parallel operation of alternators depends primarily upon the prime mover and character of apparatus employed in the distributing system. Under its simplest form a steam engine is in itself a poor prime mover for any work which requires a uniform rotation, whereas a water-wheel meets more nearly the requirements of electrical operations. In order to counteract and balance up the movements of reciprocating parts of the engine, it is necessary store up energy at one time and liberate it at the next. This effect is generally secured by means of a flywheel, whereby sufficient energy to balance up all rotative inequalities is stored up and liberated, thereby producing an approximately even rotation.

Hitherto, the selection of a single, two or three-crank engine has been a matter of choice depending upon space, economy, first cost, etc. Having selected, based upon these items, a particular type of engine, the requirements of the generator and multiple operation has been accomplished by the simple addition of a flywheel. If, after obtaining by this flywheel method a prime mover with a variation in angular velocity of about one-fourth of one per cent., a direct connected generator with a constant load is added, and the set properly operated, no fluctuating or noticeable disturbance is evident; but should a second unit, constructed exactly similar to the first and with an equal weight of flywheel, be thrown into parallel, there is often noticeable a pumping effect or cross current, which seriously interferes with the operation of the distributing system.

Even if two steam units were built from the same set of patterns, and were operated at the same steam pressure, it would never be possible to keep a fixed point on one exactly opposite a fixed point on the other for any long period of time, so that in order to keep these fixed points together a certain amount of energy must be expended by the generators. Thus the generators, having once been thrown into step, are called upon to make up in electrical energy all the differences in speed-changing tendencies of the two prime movers. This effort on the part of the generators themselves to balance up the unequal momentum of flywheels, and store up and liberate energy, is represented by actual horse power, shown in heavy cross currents alternately swinging from one generator to the other. This energy, we might say, is not apparent as a total, since it is first on one unit and then on the other; but it nevertheless exists, and, under certain conditions, may detract from the useful capacity of the generator itself. If in the choice of the type of engine there should be considered the question of variation in angular velocity as accomplished by the number of cranks, so that it might be possible to use a lighter flywheel, a point in the weight of the flywheel can be reached where, in comparison with the frequency of the alternator, a minimum synchronizing power is required. This is by far the preferable solution of the difficulty, and, in fact, will be a requirement where the frequency is fairly high (about sixty cycles), and the speed low (about seventy-five revolutions).

All cross currents generally emanate from one of two sources: First, they may be wattless, showing the transferring of current and not real energy, which, while not affecting the system, will heat up the generators. This shows a poor adjustment of fields, which, to obtain the best result, should be so regulated as to give a slightly leading or lagging current, leading in all cases preferred. Second, they may be watts, showing the transferring of real energy or horse power, which will affect the system, besides heating up the generators. This shows a poor design or adjustment of the prime mover in regard to variation in angular velocity, sometimes even caused by the engine designer using too heavy a flywheel—a flywheel which will be more than enough to give a minimum variation in angular velocity. In other words, there exists a certain synchronous relation between the speed, the momentum of the flywheel and the load, and a hunting is sure to result if the correct relations are not observed.

The influences of a synchronous load upon multiple operated generators is a question of very great importance. Under certain conditions generators can be operated in multiple with perfect results on a steady static or non-inductive load, but when to the system is added a large proportion of synchronous motors and rotary transformers, poor results often occur. The swinging or cross-current effects, which are entirely absent on two well-designed units operated in multiple, often appear to a very great extent when synchronous apparatus is used on the system. Such effect is noticed by a hunting or pumping due to the moving masses of the synchronous apparatus not acting in unison with the frequency or main generator; or, in other words, again, a case of non-synchronism of moving masses. By giving the synchronous apparatus a slightly leading current this can be reduced to a minimum. In other words, an alternating system with synchronous apparatus operated at highest power factor is in a continual state of unstable equilibrium or see-saw, and any inequalities of movement of any of the moving masses. whether on prime mover or transforming apparatus, tends to disturb the system to a greater or less extent.

After once obtaining a satisfactory prime mover, with properly proportioned flywheel, cranks, etc., the question of controlling and distributing the load on multiple-operated units must be considered. It is best that the governors of all engines should be sensitive as applied to full and no-load regulation, as thereby a constant frequency is secured, but that these same governors should be sluggish when it is necessary to take care of any sudden variation in speed, so as not to cause a variation in angular velocity. The controlling of the governor to the extent of the difference in speed between no load, full and overload should be in the hands of the electrical gallery operator, as by the independent controlling of the speed of the engine the load should be adjusted on the different units. Such an independent regulating device can easily be attached to any type of governor, and may be either hydraulic, pneumatic or electrical controlled.

The discussion of Mr. Barstow's paper turned principally upon the subject of electrically versus steam-operated auxiliaries. Mr. Barstow said that in the case of the Bay Ridge station, with steam auxiliaries using about 90 pounds of steam per horse-power hour, it was found that the boiler investment was considerably increased over what it would be for electrical auxiliaries, and this amount just about balanced the extra capacity of the engine and generator required for the electrical auxiliaries. As to the cost of auxiliaries, this depends, of course, upon the kind of equipment. With centrifugal pumps, for instance, the cost of steam equipment is just about the same as the cost for electric. A station with steam auxiliaries uses 11 or 12 per cent. total steam in the same, while electrically-operated auxiliaries use but 3 per cent.

Mr. Creden said that the matter of steam auxiliaries was investigated carefully at the Harrison Street station of the Chicago Edison Company about three years ago. The auxiliaries in the station took about 14 per cent. of the entire steam generated in the boilers and about 10 per cent. of the heat contained therein was employed in heating the feed water, leaving a difference of about 3 per cent. Mr. Creden believes that in a condensing plant there is no field for the electrical auxiliary; however, their use may be advisable where the waste gases in the stack can be utilized in heating feed water, but this seems to be the only case where an electrically-operated auxiliary can be successfully used.

Mr. Walker said that in the Brooklyn stations economizers are used, and that the economy of electrical auxiliaries comes in connection with the economizer. If no economizers were used with the electrical auxiliaries, then steam auxiliaries would be more economical. In the Brooklyn station a heater is placed between the exhaust and the condenser, which raises the temperature of the feed water to 120 degrees. Assuming that all exhaust steam from the auxiliaries is condensed in a feed-water heater, the economy of the two systems is just about the same. There are, however, many auxiliaries from which the exhaust steam cannot be utilized, such as in coal-handling apparatus; and on some loads there is too much exhaust steam for utilization in heating the feed water. Electrical auxiliaries are not reliable if connected to the main bus-bar of the station, and at the Bay Ridge station are run from the storage battery employed to regulate the excitation of the field coils. The electrical feed pump is regulated by simply shutting down a section valve and allowing only the necessary amount of water to get to the pump, which runs at a steady speed. In conclusion, Mr. Walker said that without an economizer in the boiler up-take, the steam auxiliaries in a properly designed station are the more economical. Electrical auxiliaries make it necessary to put an economizer in the up-take.

Mr. Barstow in answer to a question said that the relative merit of electrical and steam auxiliaries depends upon the conditions of the load. The Bay Ridge station runs at a load factor above 90 per cent. and there is hardly any variation in the load except a small dip at 7 o'clock in the morning for a half-hour and another at noon. The reason for selecting direct instead of alternating current motors for driving the auxiliaries was on account of the reliability of operation insured by the use of the storage battery also used for field excitation and regulation. He states that in the case of some steam plants of which a determination has been made, it would be disastrous to use electrical auxiliaries; and in almost every case a combination of the two is preferable. The question is simply one of local conditions and nothing else.

As to the question of frequencies, the adoption of 60 cycles or 25 cycles was very carefully discussed in Brooklyn. Almost three-fourths of the business is done with direct-current and in looking over past records it seemed that the use of direct-current was increasing more rapidly than that of alternating currents. In Brooklyn 3800 kilowatts of rotary converters are in use, while the entire alternating current system can be taken care of with about 600-kw. There is no doubt that for a system which has a considerable por-

tion of its load in alternating current, 60 cycles is preferable. The advantages of 25 cycles in operating rotaries and synchronous motors seem to be very pronounced. With 60 cycles running rotaries, much care must be taken in engine regulation and in the regulation of the rotary itself in order to prevent "pumping." A water-wheel system would have no trouble with 60-cycle rotaries. In Brooklyn there has never been any trouble with rotaries breaking out of step from any cause, notwithstanding station overloads and short circuits on the system which would have affected 60-cycle rotaries.

The Minneapolis, St. Paul & Suburban Railway.

The Minneapolis, St. Paul & Suburban Railway Company, which has a capital stock of $1,300,000 has purchased a right of way between St. Paul and Stillwater for an electric railway. Mr. Thos. Lowry and Mr. C. G. Goodrich, promoters of the company, have also obtained a 25-year electric street railway franchise from the city of Stillwater. While the road will compete with several steam roads, it is primarily intended to promote summer travel to Wildwood, a summer resort owned by the company, and situated about half way between St. Paul and Stillwater on White Bear Lake. The road is to have 27 miles of track, largely single, 56-pound T rail, figure-8 000 trolley wire, side pole construction with feeders on one side of the track and a No. 10 hard drawn copper double metallic telephone line on the opposite set of poles. The track will be bonded throughout with 8-inch 0000 annealed copper cables, placed under the fish plates, and supplemented near the power house by overhead returns. Fifty tons of bare copper feeder have been ordered for the 27 miles of road.

At the Stillwater end there will be one 350-hp cross-compound condensing Ideal engine belted to two 175-kw bipolar Edison generators. At Wildwood, the half-way place, there will be a new power house, 80 feet by 120 feet long, equipped with Stirling boilers, one 600-hp tandem compound condensing Allis-Corliss engine back belted to two four-pole 270-kw T. H. generators, and two tandem-compound condensing 125-hp Ideal engines. The latter are direct connected units. Electric pumps will be used in both power houses. The St. Paul end of the line is fed by a rotary converter substation in connection with the St. Paul city system. All street railway lines and power houses of Minneapolis, St. Paul, Wildwood and Stillwater are tied together by a heavy feeder system so that in case of light load one or more of the power houses can be shut down.

The local Stillwater cars will be of the ordinary 10-ton type. There are several long 10 per cent. grades in this city. The suburban trains will be similar to those built by the Twin City Rapid Transit Company at Minneapolis and used on its interurban lines between St. Paul and Minneapolis. These cars, which are 44 feet long, weigh 19 tons, doubled vestibuled and convertible for summer or winter use, are mounted on centre bearing Brill double trucks. A 52-hp (G. E., 57) motor is mounted on each axle, geared in the ratio of 1 to 2. This makes over 200-hp per car and with a 23-ton load on a level track with a pressure of 600 volts will give a speed of 33 miles an hour. Four motors are used instead of two in order to get a greater per cent. tractive effort and to reduce the dead weight per wheel on the rail.

All cars, both motor and trailer, are equipped with the Christiansen air brake, the ordinary flexible connection being made between the motor and trailer. The electric air pump is placed in the cab. Air whistles and enclosed arc electric headlights will be used. It is expected that the road will be in operation this summer.

CURRENT NEWS AND NOTES.

EXPORTS TO CANADA.—The exports from the U. S. A. to Canada for the first ten months of 1898-9, including telegraph and telephone supplies, increased from $256,935 to $341,859.

PROF. JAMES DEWAR has liquefied hydrogen at the Royal Institution, London, and has gone within 20° of absolute zero, represented by 494° Fah. and 273° Cent. below zero. One of the results is an effort to cast steel in a vacuum free from air bubbles of any kind, and Prof. Dewar is sanguine of success.

NEW YORK AUTOMOBILE CLUB is the name given to the new organization formed in this city to promote the interests that the name suggests. As yet the only formation that the club has is the application for a charter signed by five temporary trustees. There will probably not be a regular meeting until Sept. 1. Mr. H. W. Hedge, of 120 Broadway, is the secretary of the club.

ELECTRICAL EXPORT TRADE.—During the ten months ended April, 1899, the electrical machinery exports from this country increased to $2,276,694 as compared with $1,702,812 in the same period for 1897-8. The exports of scientific and electrical apparatus outside of the above, but including telegraph, telephone and other supplies, were $3,537,993 as compared with $2,324,307. The grand total, of which the bulk is electrical, is $5,814,687 as compared with $4,027,119, an increase of over 40 per cent. in ten months.

INSURANCE, ETC., FOR STREET RAILWAY MEN.—The management of the Montreal Street Railway Company announce that they have decided to increase the rate of pay of their employees, and that the new arrangement will cost the company upwards of $25,000 per year. Besides the increase in pay, the features in the new arrangement include an accident insurance, and it is stated also that the motormen and conductors who have been in the employ of the company five years or over will receive their uniforms free. The arrangement was brought about without any solicitation whatever on the part of the employees. Each employee's accident insurance will amount to $1000 in the event of death, and $500 in case of total disablement.

GENERATING ELECTRICITY UNDER DIFFICULTIES.—A physician of Belleville, Ont., has received a letter from a participant in the Soudan campaign, which contains an account of a novel method adopted for the generation of electric current for use in Röntgen ray work in the field. "The pulley of a small dynamo," the writer states, "was connected by means of a leather strap with the back wheel of a specially constructed tandem bicycle. The required velocity for the dynamo was thus obtained, and our procedure was as follows: Having carefully adjusted the circuit with the storage battery, and also with the voltmeter and ammeter, a warrant officer took his position on the seat of the bicycle and commenced pedaling When 15 volts and 14 amperes were registered, the switch, close to the handle of the bicycle, was opened and the charging of the battery commenced. As the resistance became greater, a sensation of riding uphill was experienced, and the services of an additional orderly were requisitioned for the front seat. This bicycle practice was generally carried out in a shade temperature of 110 deg. F., so that at the end of half an hour the orderlies were not sorry when the switch was turned off and the machine brought to a standstill."

MUNICIPAL LONG DISTANCE TRANSMISSION.—The town of Orillia, Ont., it is said, will be the first municipality in the world to own and operate a long-distance plant for the transmission of electric power. The plant is not yet in operation, but its installation will be completed by the middle of October next, when Orillia will have its own electric energy, controlled by itself, and its citizens will have cheaper electric lighting than they ever enjoyed before, while the town will be in a position to offer to manufacturers power for manufacturing purposes on very favorable terms. Heretofore Orillia has had an electric light plant, the electric energy being generated by steam power. At Ragged Rapids, where the plant is located, the Severn River is about 60 feet wide, and it is calculated that over 2000-hp can be developed at that point alone. Besides these rapids, there are other falls along the river, so that altogether it would be possible to develop between 8000 and 10,000-hp. The work of installation is now in progress, under the supervision of Mr. Parke, of Toronto, and Mr. C. H. Mitchell, hydraulic engineer, of Niagara Falls. The Ragged Rapids, from which the power is being developed, is 18¼ miles from Orillia, overland, and for a little over 11 miles of this distance the line will follow the highway, the remainder across country. Five miles of the latter distance is Muskoka rock and two miles swamp, so that the engineering difficulties to be encountered are quite severe. The contractors are putting in a stone and concrete dam, 43 feet high; a steel flume, with a capacity of 1200-hp, two single turbines of 480-hp each, and the power house, together with the necessary electrical machinery. It is interesting to note that this is the first plant of the kind in Canada where aluminum, rather than copper, wire is being used for transmission. The price of copper wire was so high that experiments, which proved quite satisfactory, were made with the aluminum. When the new plant is in operation, the present steam plant will be kept as a reserve, so that in case of accident to the transmission plant and line, the town will not be without light or manufacturers without power.

THE GERMAN-AMERICAN CABLE PROJECT.—The *Hamburgisher Correspondent* declares that the officials of the German Foreign Office are negotiating with British firms for the laying of the proposed German-American cable.

AUTOMOBILES IN CHICAGO.—Richard O'Neill, the manager of the North Side Carette Company, made the announcement last night that the carettes would be replaced by automobiles about Sept. 1. The company has purchased thirty automobiles in Paris, though why they should go there for the vehicles is not explained.

PACIFIC CABLE COMMISSIONERS.—At a meeting of the Canadian Cabinet the Hon. J. I. Tarte, Minister of Public Works, and Sir Sanford Fleming were appointed Commissioners to attend the conference in London, England, in connection with the Pacific cable. This conference, at which the other colonies concerned will be represented, was arranged for by Mr. Chamberlain.

MR. EDISON AND AUTOMOBILES.—It is stated that Mr. Thomas A. Edison is giving his attention to the automobile question and is now working on plans looking to the development of a light and economical vehicle of this class. Simplicity seems to be one of the prinicpal objects that he seeks to attain. He is also giving attention to the matter of reducing noise. Mr. Edison is reported to have said that when the automobile is perfected the price of a buggy or two-seated carriage will be less than that of a good team of horses and it will cost only one-fifth as much for maintenance.

INTERNATIONAL AUTOMOBILE CUP.—At the last committee meeting of the Automobile Club of France the preliminary conditions of the races for the international challenge cup were drawn up as follows: "(a) Cup to be in keeping of the Automobile Club de France. (b) Any club in any country can issue a challenge for it in the name of one of its members. (c) Cup to belong for the time being to the winning club, and in case of the dissolution of the club to be passed to the leading club of the country. (d) First contest to take place in France. Afterward in the country of the winning club. (e) Name to be given to the race and distance to be decided at a future meeting." The matter is being actively discussed by leading American automobilists.

DETROIT MUNICIPAL RAILWAY.—The question of submitting to the vote of the people the proposition for the municipal ownership of street railways under the commission plant was not decided on June 22. The special meeting of the Common Council resulted, after a parliamentary tangle, in the reference of the questions involved to the Committee on Streets and Ordinances. A resolution was offered calling a special poll for July 10. It was declared out of order by the president of the council, who submitted a legal opinion to the effect that the proposed poll was unauthorized by the city charter, and would be illegal for various reasons. The resolution, together with the legal questions involved, was finally unanimously referred to the committee.

JAPAN AND PATENTS.—The Government of Japan has given notice of its intention to be a member of the International Union for the protection of industrial property, and its accession will become effective on July 15. The association looks to harmonizing the laws in the various countries which are members, on the subjects of patents, designs and trade-marks. It comprises most of the principal European countries except Germany, which insists upon certain modifications, and is looked upon as ready to accede soon. Japan's entry is significant to patent interests. Under the provisions of the union, inventors filing applications in one country have seven months within which to file the applications in any other country, the latter taking the date of the original application. A period of four months is allowed for trade-marks and designs.

ELECTRICITY FOR NAVY DRY DOCK.—The Navy Department has advertised for bids for the erection of the dry dock at the League Island Navy Yard, which was authorized by the Act of May 4, 1898. The general dimensions of the dock are to be as follows: Length on coping from head to outer gate sill, 750 feet; length on floor, 717; width on coping in body, 144; width on floor, 80; width on coping at abutment, 104; width at entrance on mean high-water level, 101; depth from coping to mean high-water, 66; depth from coping to floor, 40; draft over sill at mean high-water, 30. The generating sets consist of vertical compound engines with two dynamos, directly connected to each engine. There are to be eight steel boilers. The caisson is to be a floating gate, of boat form, constructed of steel. There are to be electric power capstans and winches.

LIVE WIRES IN CHARLESTON, S. C.—Original measures have been taken in Charleston, S. C., to protect firemen from the danger of contact with live electric wires. By the terms of an ordinance on the subject each company having the right to string electric wires must connect its station with the fire alarm system, and on the occasion of each fire alarm must send an emergency wagon and one or more competent men, with necessary apparatus and tools, to the locality of the fire, where they must act under the direction of the officers of the Fire Department. In addition, a special signal has been arranged, in obedience to which the electric companies must turn off the electric current in the district of the fire. Heavy penalties are provided for neglect to comply with the ordinance, and they are cumulative for each day of neglect.

ACTIVITY OF INVENTORS.—A special dispatch from Washington says: "The receipts of applications for patents on inventions are larger now than they have ever been, save in the years 1896-'97. In May there were 3647 applications received at the Patent Office, nearly a thousand in excess of May, 1898. Judged from receipts the largest invention work is now being done in the mechanical and chemical lines. A significant decline has been in progress in bicycle inventions, the heaviest rush in which was about two years ago, when the division devoted to that work was overtaxed. Now it has become necessary to assign other lines of work to that division. For a year this class of inventions has been declining in numbers and a marked decrease has set in in the last six months. Patent Office officials interpreting this significant decline say that it puts bicycles on a par with other vehicles as a large but steady industry." Automobiles bid fair to take the vacant place of leadership.

A NEW TRANSFORMER.—A patent was issued June 20 to Gustave A. Scheeffer for an improvement in the construction of transformers, consisting in the use of ventilating slots or recesses of such a character as not to enlarge transformer cores beyond the size of cores not provided with ventilating recesses. The invention also provides for an improved form of wedge or distance piece interposed between the transformer cores and coils, which will permit of the ventilation of the spaces in which the said wedges or plugs are placed. In applying the invention to the rectangular shell type of transformer, it is stated that the corner portions of the cores have a larger cross-section, diagonally, of metal than the sides of the cores, thus presenting a cross-section at the corners greater than is absolutely necessary for the passage of the lines of force. Advantage is taken of this fact, and the corners of about half the number of laminæ are cut off, the trimmed laminæ being distributed among those untrimmed, thus forming fissures from which to radiate heat. In the case of shell transformers, besides clipping off the corners, a triangular piece is notched out midway of the length opposite the middle rib.

ELECTRIC LIGHT FIRES IN NEW YORK.—In the annual report of the New York Fire Department, Fire Marshal Seery says: A matter of considerable importance is the subject of electric lighting. After a number of exhaustive examinations I am full convinced that a few of our fires are the results of either defective insulation or imperfect wiring. As a matter of public safety, and to provide, if possible, against repetitions of this nature, I think it advisable to recommend the licensing of all persons handling electric light appliances. Would also recommend that regulations be established providing for cut-out boxes on the inside of buildings near the main entrance, so that currents may be readily turned "on or off," as occasion requires. This will in a measure lessen the danger to which firemen may be subjected from live wires while in the performance of their duties. In order to more clearly determine the location and cause of fires, thereby placing the responsibility where it belongs, where electric light wires are located, I would respectfully suggest, and do hereby recommend, the permanent employment of an expert electrician, to be attached to this bureau, whose duty it shall be to make such investigations, or to perform such other duties as is required.

NATIONAL ELECTRICAL CODE.—The 1899 edition of the rules and requirements of the National Board of Fire Underwriters for the installation of wiring and apparatus for electric light and power, has been issued. The code is accompanied by a 19-page supplement containing a list of electrical fittings that have been examined and approved by the Underwriters' National Electric Association for use under the requirements of the code.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—The preliminary announcement has been made of the forty-eighth annual meeting of the American Association for the Advancement of Science, to be held at Columbus, Ohio, Aug. 21-26, 1899, and of the meetings of several affiliated scientific societies that will hold their sessions in the same city at the same time. Prof. B. F. Thomas, of the Ohio State University, is the local secretary, to whom all letters relating to local arrangements, transportation, hotel accommodations, etc., should be addressed. Among the affiliated societies which will hold their meetings at this time will be the Society for the Promotion of Engineering Education.

ELECTRIC VEHICLE.—A patent was granted June 20 to W. M. McDougall, for an electric vehicle having mechanical means for changing the gearing between the motor shaft and the axle so as to enable the former to run at a substantially constant speed, thus maintaining a constant counter e. m. f. and a constant output of the storage battery. The motor is capable of movement on the motor shaft in such a way as to throw the pinion on the latter shaft out of engagement with one gear, and into engagement with another gear of different pitch, these gears being respectively an external or spur gear and an internal gear. Means are also provided for mechanically changing the direction of rotation of the motor.

A SUBSTITUTE FOR HARD RUBBER.—A company has recently been organized in New Jersey, with a capital stock of $5,000,000, to manufacture a compound, called "Xelton," which, it is said, is an excellent substitute for hard rubber. The advantages claimed for this new substance are as follows: It is not as brittle as hard rubber; heat and cold do not affect it; it neither contracts nor expands; it is tought and resilient; it weighs considerably less than hard rubber, and it can be made fireproof, so that for many purposes it will have a great advantage over rubber. Xelton is said to be invaluable for electrical insulation and for battery jars, and is much cheaper than hard rubber. The Xelton Company has purchased a large factory in Frankford, Philadelphia. Messrs. Stahl & Straub, bankers, of Philadelphia, are interested in the financial management of the enterprise.

ELECTRIC FIXTURE COMBINE FAILS.—The attempt to form the American Gas and Electric Lighting Fixture Company, a trust movement, has not succeeded. The company was to have included all the important gas and electric fixture manufacturers in New York, Philadelphia, Cleveland, Chicago and San Francisco, and was to have been capitalized for $15,000,000, of which $6,000,000 was to have been preferred and $9,000,000 common stock. The movement was started outside the trade proper. Options on the plants desired were obtained until May 1. On that date, the promoters found it necessary to secure extensions of options for a month, but they were unable to extend them after June 1. According to the representative of one of the large manufacturing firms, the trust failed because the promoters did not obtain the necessary capital. They had to raise a certain sum by a certain date, and did not do so.

ELECTROSTATIC MEASURING INSTRUMENT.—In a patent granted June 20 to Elihu Thomson, an electrostatic measuring instrument is described designed particularly for the measurement of very high potentials. The measurement of potentials of 10,000 volts or more which are now commercially used is at present a question of calculation in the lack of an efficient measuring instrument. The instrument is of the electrostatic type and is enclosed in a glass chamber in which there is such a high vacuum that electrical discharges are prevented from passing between the opposing surfaces of the voltmeter. This admits of securing a greater attractive effect by permitting of the close approach of the two parts of the mechanism which are of opposite potential. Means are supplied for damping the movement and for furnishing a restoring torque to bring the needle to zero. The needle inside indicates by means of a scale on the outer surface of the vacuum case.

A NEW STORAGE BATTERY.—A patent was granted June 20 to William M. McDougall for a storage battery, the object in view being to provide a battery in which the internal resistance will be low; the surface of contact between the active material and the conductor of the plate will be large; the tendency of the active material to become detached from the plate will be reduced to a minimum; the weight of the plate will be small, and the tendency of the plate to warp or buckle will be slight. The supporting plate is of non-conducting material, preferably a composition containing rubber formed by a molding process into a single piece. The plate is provided with horizontal rectangular perforations arranged in vertical and horizontal rows. The horizontal ribs formed by these perforations are also perforated vertically, and the top of the plate has a groove into which these vertical passages lead. Lead wires are placed in the vertical passages or holes, and united at the top to a crossbar which fits into the top groove. The horizontal perforations are then filled with active material from opposite sides, which material becomes knitted around the vertical lead conductors and is thus firmly anchored to the plate.

A NEW CHEMICAL INDUSTRY AT NIAGARA FALLS.—A new plant for the manufacture of caustic soda, bleaching powder and other chemicals is now being built by the Acker Process Company at Niagara Falls. The buildings will cover an area of about 100 feet wide by 440 feet long. One of these buildings, to be built entirely of brick, is now in the hands of the contractors. The company, which is composed of New York and New Jersey capitalists, proposes to build works of suitable capacity to turn out a very large proportion of the bleaching powder consumed in the United States and a considerable proportion of the caustic soda. It owns patents covering the important features of the process and has a number of patents pending, some of which it considers of even more importance than those already issued. A contract has been made with the Niagara Falls Hydraulic Power & Manufacturing Company for over 3000 electrical horse-power to be delivered in the form of direct current of over 8000 amperes at 300 volts pressure. This current is said to be about fifteen times greater than that used in any works of similar character thus far, and will be used in a single series of decomposers. Each decomposer will, therefore, have about fifteen times the output of the units successfully employed up to date, the actual dimensions of the apparatus being but slightly greater than others turning out one-fifteenth as much soda or chlorine. The fact that a current of this volume can be employed in such a small space is due to the employment of a molten electrolyte instead of a solution. The conductivity of molten salt compared with brine, whether the latter be heated or not, is very large, and owing to the fact that no water is present in the former case, no secondary reactions are possible. The electromotive force required in each particular apparatus is somewhat higher than where brine is decomposed, owing to the fact that the electrolyte is maintained in a molten condition by the current which also decomposes it. But the slightly additional cost due to the increased voltage is more than offset by the fact that the caustic soda is obtained directly in an anhydrous state ready for packing, thus obviating the evaporating and boiling down process heretofore essential. The concentration and finishing in the brine processes of each ton of caustic soda requires the consumption of about 2½ tons of coal, which, it is stated, is entirely saved in the Acker process. The chlorine is given off in the usual way, except that it has the advantage of being dry, a fact of importance when the gas is to be absorbed by lime in the manufacture of bleaching powder or chloride of lime.

EXPORTS OF ELECTRICAL MATERIAL FROM NEW YORK.—The following exports of electrical material are from the port of New York for the week ending June 20: Antwerp, 39 cases electrical material $1829; Bremen, 9 cases electrical material $50; British Australia, 8 packages electrical material $348, 71 packages electrical machinery $14,890; British West Indies, 12 packages electrical material $333; British East Indies, 8 cases electrical material $401, 9 cases electrical material $534; Berlin, 1 case electrical material $15; British possessions in Africa, 27 packages electrical material $731; China, 47 cases electrical machinery $2505, 5 cases electrical material $130; Chili, 3 cases electrical material $47; Central America, 19 packages electrical material $347; Cuba, 9 cases electrical material $188, 9 cases electrical material $188; Dutch West Indies, 1 case electrical material $23; Dutch East Indies, 1 case electrical material $22;

Genoa, 6 cases electrical material $197; Hamburg, 37 cases electrical material $2949; Hong Kong, 15 cases electrical material $470, 3 cases electrical machinery $160; Havre, 13 cases electrical material $1586, 4 cases electrical machinery $310; Japan, 21 cases electrical material $1324, 35 cases electrical machinery $1882; Liverpool, 11 packages electrical material $3975; London, 24 packages electrical material $1115, 5 packages electrical material $300; Mexico, 35 packages electrical material $1613, 32 packages electrical machinery $13,788; Manchester, 70 cases electrical machinery $350; Marseilles, 283 cases electrical machinery $25,000; Newfoundland, 2 cases electrical material $24; Nova Scotia, 1 case electrical material $50; Naples, 2 cases electrical material $50; Odessa, 43 packages electrical material $925; Peru, 10 packages electrical material $533; Porto Rico, 25 packages electrical material $433; Southampton, 2 cases electrical machinery $75, 5 packages electrical material $415; St. Petersburg, 19 packages electrical material $1205; Siam, 16 cases electrical material $367; Stockholm, 5 cases electric motors $475; U. S. of Colombia, 13 packages electrical material $161.

LETTERS TO THE EDITORS.

The Feasibility of Telephone Repeaters.

To the Editors of Electrical World and Engineer:

Sirs:—Your reference to President Glidden's offer concerning the telephone repeater, brings my attention again to this interesting subject. The extensive and growing use of long-distance telephone lines appears to make the demand for a telephone repeater imperative, and little doubt is there that its advent is only a question of the demand. That the problem cannot be solved on the old lines of the telegraph repeater seems fairly settled by the conditions of the case.

I do not consider that this side of the telephone art has been seriously approached, in view of the fact that among seven thousand patents on telephone improvements less than fifty relate to repeaters, and they are all either impractical or entirely inoperative.

The telephone being a comparatively long-distance instrument, its use without a repeater has until recent developments been taken for granted—perhaps too much. The possibilities of a telephone repeater are so vast that the telegraph relay in comparison fades into comparative insignificance.

I am of the opinion that no mere mechanical arrangement of levers and springs can ever be made to respond to the exceedingly delicate vibrations of the receiver diaphragm. Imponderability of operative parts seems to be a first condition of the problem.

I feel confident, however, that the problem has a practical and eventually a comparatively simple solution on lines as simple as the receiver itself. In fact, I have made a repeater that has given fairly good articulation of speech in the second line, while musical notes are very distinctly repeated.

This problem, like many others in the electric arts, is a purely electro-mechanical one, and, as a matter of fact, must have a definite solution in nature. In view of our wider opportunities and breadth of view, the telephone repeater can hardly be considered as difficult a problem to-day as was the repeating relay of the telegraph in the day of its invention. It is my guess that if one-tenth part of the alluring prize referred to were devoted to the application of brains and experiment numerous practical telephone repeaters would be forthcoming. I would suggest that a few of the inventors who have recorded failures publish them as I have done, to prevent them being repeated.

F. JARVIS PATTEN, C. E. and E. E.

NEW YORK.

Theory of the Induction Coil.

To the Editors of Electrical World and Engineer:

Sirs:—I attended, a few evenings ago, a meeting of scientific gentlemen and the question was asked, what was the latest thing in electricity? The immediate answer was the Wehnelt interrupter. It is a simple addition to the induction coil which we all know all about, except possibly just how it works. No doubt it does work by the electrolytic fluid being separated from the bit of platinum wire immersed in it by the generation of gas due to electrolysis or to vapor due to the heat that is generated. This is all true, and yet I think that the full merits of the interrupter have not been brought to public notice.

To do that requires us to consider the theory of the induction coil carefully. The nearest analogy is perhaps the hydraulic ram. In both the potential, or in the ram, the head of water is raised by the sudden checking of the flow of the current, and the extent to which the potential is raised is limited by the time it takes to stop the flow. This in the ram is done by a valve. In the coil it is done by breaking the circuit. It is evident and is well known that the current does not stop the instant the circuit is broken, but is continued for a very small space of time in the spark that is seen almost always when the current is broken. In a well arranged induction coil means are taken to reduce the spark as much as possible by adding capacity by a condenser just across the part where the spark occurs, and also by making the self-inductance of the primary, which is the cause of the spark, as small as possible. To do this you are compelled to arrange the primary coil with as few turns of wire as you can, and so reduce its magnetic effect on the core and secondary. A large number of turns on the primary is what is wanted to produce a powerful magnetization, but the number is limited by the fact that the self-inductance increases nearly as the square of the number of turns.

With the Wehnelt interrupter it is necessary to add self-inductance to that possessed by the primary as ordinarily constructed. This would seem to make it plain that a much more efficient coil could be especially designed to work with the Wehnelt interrupter by increasing the number of turns on the primary to give a self-inductance equal to the sum of the coil as ordinarily wound, and the self-inductance that has to be added to make the interrupter work to the best advantage. I think we may hope to have coils so made in the future that they shall excel the efficiency of those now produced.

J. P. WINTRINGHAM.

NEW YORK, N. Y.

What is a Two-Phase Current?

To the Editors of Electrical World and Engineer:

Sirs:—Some of the difficulties in the treatment of polyphase currents are necessary, but a peculiarity in names seems to be responsible for them. Using Steinmetz's definition "if the polyphase system consists of n equal E. M. F.s. displaced from each other by ½ of a period, the system is called a symmetrical system." According to this definition, a two-phase symmetrical system should have two E. M. Fs. differing from each other by 180°. This is precisely what we have in the so-called "single-phase" alternating current, which is therefore to be considered as a two-phase symmetrical system. The three-phase system has three wires in each of which the E. M. F. is 120° behind the preceding. It is therefore a symmetrical three-phase system.

A four-phase system should have four wires, the E. M. F. in each being 90° behind the next. This is seen to be the condition of things in the "two-phase" system, which is therefore a complete and symmetrical four-phase system. Thus considered, the general formulæ for symmetrical polyphase systems can be immediately applied to the "single-phase" and "two-phase" systems without modification. When regarded as a two-phase system the ordinary alternator may be considered to have a star winding if the armature coils are all in series, or a mesh winding if the two sides of the armature are connected in parallel. In the former case the neutral point is at the middle of the armature winding.

According to this idea, in the expression for the instantaneous power in each wire we have* $p = E I (\cos w - \cos (2B - w))$ where w is the angle of lag, and B is the variable angle (different in each wire).

Fither E or I is ½ as great as usually measured, according as the star or the mesh winding is used, but since the expression is identically the same for each wire the total power is as usually given. For all systems higher than two, the variable part of the expression disappears from the sum of the terms by symmetry, showing that the flow of power is constant.

This way of regarding the "two-phase" system is less important because of the fact that the "single-phase," "two-phase" and three-phase systems are commonly considered each by itself, rather

*Steinmetz Alternate Current Phenomena, p. 364, where the formula is erroneously given as E I (cos w—sin 2 B—w).

than as special cases of more general, and it is no doubt too late to attempt to name the systems anew, but the statements here given will perhaps make the cases clearer with the student, and banish the need for such names (and ideas) as "hemisymmetrical" systems.

It may be added that for symmetrical distribution, one wire, and only one, is needed for each phase. Where the number of phases is even, and the neutral points in the star winding are not all connected, a common return may be used for as many of the pairs of phases as desired, making the total number of wires equal to one more than one-half the number of phases.

It may not be out of place to add that one "peculiarity" of balanced polyphase systems, viz., that the sum of all the currents at any instant is zero, is showed alike by all other systems, alternating or continuous. It is in fact a case of Kirchoff's law that the sum of all the currents flowing from any point is always zero, unless there is a capacity at that point.

KNOXVILLE, TENN. CHARLES A. PERKINS.

Two-Phase Versus Three-Phase Systems.

To the Editors of Electrical World and Engineer:

Sirs:—I have read with much interest the recent discussion in your columns on the relative merits of two-phase and three-phase systems, and have been surprised to see that several engineers attribute to two-phase currents a special advantage from the point of view of independence of circuits. Since there are, however, reservations as to this point, it may be of interest to direct attention to the following:

1. The independence of two-phase circuits exacts the employment of two separate transformers and of four line conductors instead of three. Even then, the influence of one circuit on the other is only negligible in the case of alternators with small armature reaction. If, on the contrary, it is desired to work the alternators at their maximum capacity, very often considerable and troublesome mutual actions are encountered. For example, having recently a two-phase system to install in a lighthouse employing an alternator of large self-inductance, I found it necessary to make many modifications before obtaining an e. m. f. in one of the circuits which did not vary more than 10 per cent. when the load on the other circuit varied from no load to full load. This action, it may be added, can be easily explained by calculation. As the present tendency is to obtain a greater output from alternators by accepting the large drops in potential, and compensating for them by compounding, the disadvantage referred to should not be neglected, and consequently the principal advantage of the two-phase system is very problematical.

2. Two-phase high-voltage alternators with four slots per pole give a curve of e. m. f. having harmonics more largely developed, and therefore more troublesome, than in the case of three-phase machines of six slots.

3. The advantage of being able to employ a two-armature machine of the inductor type with one phase on each armature, as has very ingeniously been done by Mr. Fischer-Hinnen, is equally problematical, I believe, because the reaction of one of the armatures makes itself surely felt on the other, at least if the magnetic circuits are not made completely separate and separably excited by two field windings.

4. Finally, the three-phase system, to be judged with equity, should not be supposed to be operated with separate transformers on the three legs, but rather with symmetrical three-core transformers. These latter, which appear to be little employed in America, are largely used in Europe, where their advantages, not only theoretically but practically, are recognized. While such transformers on the one hand are more expensive than the three corresponding separate transformers, on the other hand, they play the part of automatic compensators in equalizing the voltages on the three legs of the circuit when the loads are unequal. This arises very simply from the fact that the magnetic flux in one core being a resultant of that in the two other, the three fluxes are necessarily sensibly equal.

It is due to the employment of these compensating transformers that three-phase distributions have surmounted the difficulties of unbalancing, which are very marked when the circuits are supplied direct from an alternator or by means of separate transformers. For example, the Compagnie Electrique de la Loire, which distributes electrical energy for lighting and power in the district of St. Etienne, over a distance of more than sixty miles, encountered difficulties in balancing which compelled it to employ a fourth wire as long as separate transformers for each phase were used. They were induced to replace the latter by three-phase transformers, with the result that no further difficulties with respect to balancing were encountered, and the fourth wire is no longer employed. If one bears in mind that the two-phase system does not permit the employment of these compensating transformers, that it requires four conductors instead of three, and that it offers no material advantage with respect to construction and electrical material, I may be permitted to have a personal preference for the three-phase system, and to believe that it will finally be employed everywhere to the exclusion of the two-phase. This does not imply that the arguments which have been presented in favor of the equality of the two systems have not a real value. As in the case of one's hands, though having a similar value, there is always one which is finally employed almost exclusively in preference to the other.

PARIS, FRANCE. A. BLONDEL.

Energy Direct from Carbon.

To the Editors of Electrical World and Engineer:

Sirs—Under the heading, "Electrical Energy Produced Directly from Carbon," in the London *Electrical Review* of May 12 (see also Digest of THE ELECTRICAL WORLD AND ENGINEER of June 3, 1899), Dr. D. Tommasi has reiterated his claims, now nearly twenty years old, that carbon is dissolved and oxidized by salt water in the presence of lead peroxide, and that electrical energy is evolved by this oxidation in his "battery with carbon electrodes."

This battery consists, according to the inventor, of two carbon electrodes immersed in a solution containing sodium and calcium chlorides, one of the electrodes being surrounded by and in contact with lead peroxide. He alleges that electro-chemical reactions take place resulting in the oxidation of the carbon *of one electrode* to carbon monoxide and carbon dioxide and in the reduction of the lead peroxide to metallic lead. He further alleges that with *acidulated water and a porous jar* oxide of copper also performs the function of oxidizing the carbon, being thereby reduced to metallic copper.

On the assumption that these allegations are true the electro-chemical reactions corresponding to the formation of carbon monoxide and carbon dioxide with reduction of lead peroxide to metallic lead are respectively

$$(1).\quad 2C + PbO_2 = Pb + 2CO \text{ and}$$
$$(2).\quad C + PbO_2 = Pb + CO_2$$

The first of these alleged reactions absorbs energy and cannot evolve it in any form. The second evolves (supposing the CO_2 to be formed in solution) 102,840 — 63,140 = 39,700 calories, sufficient to give a possible electromotive force of $\frac{39,700}{4 + 23,240} = .43$ volt. Dr. Tommasi, by an erroneous calculation, deducted double this electromotive force. This error seems to have been an unfortunate (or possibly fortunate) one, as it makes his theoretically deduced electromotive force agree closely with that which he claims to have observed experimentally. It was fortunate to have his theoretical and his observed figures agree, but it was unfortunate to have his experimental results nearly double that which would be theoretically possible. It shows conclusively that the observed electromotive force was due to an entirely different cause from that which he had assigned

However, since the reaction represented above in equation (2) is a theoretical possibility, there remains to be determined only the question of fact, whether it does or does not take place. The detection of *volts* proves nothing as to this question, which is evident from the fact that Dr. Tommasi obtained experimentally nearly double the volts theoretically possible from such a reaction. Dr. Tommasi states positively that the oxidation of the carbon to the monoxide and dioxide takes place, but he does not state the particulars of his investigations nor give experimental data establishing those facts.

Preposterous as may seem the statement that carbon reduces lead peroxide in a cold bath of sea water, it would probably not be proper to deny the assertions of Dr. Tommasi point blank without referring to experimental proof. I therefore constructed several cells of the types described by Dr. Tommasi, placed them on short-circuit and allowed them to remain short-circuited indefinitely, taking all necessary precautions to exclude all other reactions, except

those alleged to occur, and to exclude all causes that might mask the results.

It is well known, and would probably be admitted even by Dr. Tommasi, that when a galvanic battery is short-circuited the electro-chemical reaction always proceeds with the greatest rapidity, regardless of polarization or depolarization. If the statements of Dr. Tommasi were true, therefore, his battery on short-circuit would result in the rapid production of oxides of carbon and metallic lead, exactly as a zinc battery on short-circuit rapidly produces zinc salts and reduces whatever depolarizer is present. It was found, however, that the Tommasi batteries, after standing indefinitely on short-circuit, did not produce a particle of carbon monoxide, carbon dioxide, hydrogen, metallic lead or metallic copper. There was no evidence of any chemical change whatever.

A bubble of gas having a diameter of one-tenth millimeter is easily visible to the naked eye. Such a quantity of carbon dioxide would weigh .000,000,001,03 gram and the carbon in it would weigh .000,000,000,27 gram. If this quantity of carbon were oxidized every second in the short-circuited Tommasi battery, it would require 116,000 years to oxidize one gram. But it was found that not even a microscopic trace was formed in ten days. Hence, by this process the oxidation of one gram of carbon in the short-circuited battery would require at least several hundred billions of years. Yet this distinguished scientist has for years been periodically republishing his claims, apparently for the sole purpose of posing as a great discoverer, although his error has been pointed out to him at least once before.* He certainly cannot claim that he has not had time to experimentally verify his theory.

Aside from the question of electro-chemical action, the structure of this battery, on the supposition that the reaction does occur, is, to say the least, absurd. What tyro would propose to construct a galvanic battery with two electrodes of the same substance, soluble in the electrolyte, and expect to get electrical energy from the oxidation of one of the electrodes? If anyone should propose such a structure with electrodes of zinc, iron, copper, cadmium, or any other metal, what would be the verdict?

Such "discoveries" as this carbon battery, though made by an eminent Doctor of Science, do not constitute science nor promote scientific progress. In science mere allegations have no place. Why did not Dr. Tomassi tell the truth by simply saying that he obtained a transient electromotive force, but made no investigations to determine its cause?

CHAS. J. REED.

PHILADELPHIA, PA.

*Electrical World, Nov. 21, 1896.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

By CARL HERING.

DYNAMOS, MOTORS AND TRANSFORMERS.

Battery Boosters.—GIRAULT.—The first part of an article discussing analytically the quantitative relations when a dynamo is placed in series with a battery, both together being in parallel with the main generators, the battery being used for keeping the load on the main generators constant; the method is the one frequently used in railway power plants. He first studies the case of a series-wound booster, deducing equations for the relations, and finds that this method enables one to maintain constant the current from the main generators and the voltage at the bus bars. The theoretical conditions are, however, realized only when the booster is running on that part of its characteristic which is below the bend; the construction of such a machine presents no special difficulties. It is recommended to design the machine so that the field can be shunted with a resistance which enables it to be regulated at times, if necessary. It is best to drive the series booster with a shunt motor connected to the feeders as they leave the station; a practically constant speed is obtained if a small series demagnetizing winding is added to the shunt winding. He then begins the discussion of what he calls a perfect booster. He shows that it is possible to obtain a perfectly constant voltage at the terminals of the distribution whatever be the value of the current, or the e. m. f. and internal resistance of the battery. If the armature is in series with the battery and if the voltage of the battery varies a certain amount, that of the booster should change by an equal amount, but of opposite sign; this is accomplished by a double field winding, one a constant and the other connected to the terminals of the battery, the latter being the one by which the variations of the voltage will be produced; the constant excitation may be produced either by the constant current from the main dynamos passing through a series winding, or by a shunt coil connected to the bus bars. To compensate for the internal resistance of the booster itself a small series winding carrying the booster current is added. He shows analytically that this method is theoretically perfect, but there are practical difficulties owing to the excessive field windings; it is a differential system, the voltage generated (apparently by the difference in the two field coils) is exactly equal to the difference between the voltage of the battery and that of the bus bars. The method is said to work perfectly, but requires special care.—GIRAULT. *L'Ind. Elec.*, May 25.

REFERENCES.

Theory of Three-Phase Motors.—OSSANNA.—A very long article in which he develops a graphical theory of revolving field motors, which is also applicable to the ordinary transformer: it enables all the quantities such as the primary current with its two components the watt and the wattless, the input and output, the slippage and efficiency, to be determined graphically. It is based on the assumption of a constancy of magnetic resistance, leakage coefficients and sinusoidal rotating fields.—OSSANNA. *Zeit. fuer. Elek.*, May 7, 14 and 21.

POWER.

Transmission and Distribution.—PARSHALL.—A reprint of a brief paper read before the Institution of Civil Engineers. Concerning the economical generation he states that there is little difference in the efficiency, cost and maintenance whether continuous, alternating or multiphase currents are used. With overhead lines there is of course a great gain in increasing the voltage, but with underground cables 20,000 volts may be said to be the safe limit. The economical distribution is to be determined with reference to the conditions to be maintained in the converters and circuit. A number of small substations will be found to be more economical from a commercial standpoint than if each were a complete generating station, but a general rule as to the most economical number of substations cannot possibly be given; for a particular case of fairly uniform distribution over a large area at the rate of 1000-kw or more per sq-m, a radius of distribution of half a mile would be warranted from economical considerations. With short feeders, as would be used with substations, there is the further advantage that the variation in voltage is less, which simplifies the switchboards and gives better and more economical service. Single-phase transmission may in general be said to have had its day; proper demands for power must always be considered, and the single-phase motor has not been a success. Many engineers believe that multiphase transmission with rotary converters and continuous current distribution, will be the ultimate system of dealing with large powers over an extended area. A popular formula among the more progressive engineers, is to use multiphase transmission at a frequency of 25 to 50 and at 5000 to 40,000 volts, according to the distance and condition of the transmission. There is little choice between two-phase and three-phase currents: the conditions favoring the three-phase transmission are that a small amount of copper is required and there is great flexibility in the use of transformers; without increase in complication, the three-phase system requires only three-fourths of the weight of copper that the two-phase system does, and the transformers may be connected for six-phase transformation, a condition very favorable for practical working.—In the discussion Mr. Parker defended the high-tension continuous-current system, with which he has had much experience and has many machines working successfully up to 2500 volts; he thinks they could be used commercially up to 5000 volts. Synchronizing has caused great trouble with alternating current plants; in all districts which could be run by 5000 volts, the continuous current system should be preferred. Crompton believed that the commercial limit of continuous currents had been exceeded in the case of

electric traction. The practice concerning the winding of generators and motors was about as follows: Machines of 500-kw could be successfully wound to give 10,000 volts; dynamos of over 700-kw, 15,000 to 20,000 volts. Concerning the substations, he said it was not important whether they were spaced a quarter of a mile or three-quarters of a mile apart. In some calculations he had made on a proposed electric railway he found that spacing the transformer station "from four to seven apart" (presumably meaning miles) made no difference in the cost. Owens stated that line losses from static discharges were not serious until 60,000 volts had been reached, after which they increased very rapidly. There was a tendency in America to increase the inductance of alternators so that on short circuit they would take no more than three times the normal current, and this did not harm them; all safety devices are then dispensed with, which has proved to be a great advantage.—PARSHALL. *Lond. Elec. Eng.*, June 9.

Cranes.—PITT.—In a short paper read before the Institution of Civil Engineers, he discusses the various forms of cranes and the power to drive them, with special reference to the electric crane. The chief success of the latter is due to the ease with which the power is transmitted from the stationary source to the crane. He seems to prefer series-wound motors for the single motor type of cranes; jib cranes are usually constructed as two-motor machines, one for lifting and one for slewing. He seems to favor the worm wheel, claiming that if properly designed it had a very respectable efficiency; the ordinary formulas for worms if used with the proper coefficient of friction, will give results borne out by practice. For the controlling gear the tendency has been to adopt liquid resistances and also controllers like those used on railways. In Germany considerable attention is given to the problem of recovering the lost energy in lowering the load, but he doubts the practicability of this. He believes that the hydraulic crane will always continue to be used, but admits that the electric crane is a very serious rival; the latter is more expensive, but the generating and transmitting plants are less expensive. Generally speaking, he believes that for single cranes, or cranes with a large range of portability, steam is best; where the circumstances warrant a central power station, or where the power is to be conveyed to any distance, electricity should be used; for overhead travelers, electricity is best.—PITT. *Lond. Elec. Eng.*, June 9.

Advantages of Different Kinds of Power for Railways.—PARKER.—A reprint, with the discussion, of a short paper read before the Institution of Civil Engineers. The various forms of power are briefly compared and a table of the operating cost per car mile by the various systems, is given, as also some brief data for accumulator traction; otherwise the article contains little that is new. The weight of accumulators, he says, has recently been reduced so that for one-hp hour delivered to the car (whether he means to the accumulators, to the motors or to the axles, is not stated) the weight is 56 pounds "inclusive" (it is not clear whether this includes the motors and gears, the improvements in which he says have enabled this figure to be reached); 5 cwt. of cells is therefore sufficient to operate a car, as against 16 cwt. two years ago. The following data are from what he considers one of the best examples which he has had the opportunity of testing. The weight of the car complete without batteries, 9 cwt.; batteries, 5 cwt.; total weight with four passengers, 20 cwt.; discharge on the level, 12 amperes at 80 volts at 9 miles per hour, approximately 1.5-hp; safe distance, 40 miles; one motor, double reduction gear, 1200 rev.—PARKER. Lond. *Elec.* and *Elec. Eng.*, June 9.

REFERENCES.

Influence of Electricity on Railway Locomotion.—After calling attention to the objections and shortcomings of steam locomotives and giving some figures concerning the operation of the underground electric railroad in London, and the overhead one in Liverpool, he discusses the advantages of electric traction, even advocating its use for heavy freight traffic besides passenger traffic. The advantages, particularly for underground urban lines, like the Metropolitan in London, are brought out.—THWAITE. *Eng. Mag.*, June.

Budapest.—A brief but well illustrated article on the electric railways of that city of 220,000 inhabitants, the total mileage being 104. The slotted conduit system which is used on some of these was installed as early as 1889 and has been running ever since; it was the first application on a commercial scale of the slotted conduit system. The underground tunnel road is also described and illustrated.—DUBSKY. *Cassier's Mag.*, June.

Haute-Silesie.—An illustrated description of this railway in which the Walker apparatus seems to be used largely.—*L'Energie Elec.*, April 1.

Electric Yachts in Holland.—A brief illustrated description of some representative types used in that country. It is estimated that the price of an electric yacht is considerably higher than of a steam yacht, as the cost of the electric installation, especially the battery, is much more expensive than the steam boiler and engine; moreover the steam launch has a greater steaming radius, but these are the only advantages of steam over electricity.—GELDER. *Cassier's Mag.*, June.

Electric Cabs in London.—A brief description of the works of the London company with two illustrations of the cabs.—Lond. *Elec. Eng.*, June 2.

Surface Contact System in Tours.—An illustrated description of this installation in which the Diatto system is used (see Digest, May 27 and June 10).—*Elek. Zeit.*, June 8; a brief description with some illustrations is given in the *Elec. Rev.* June 14.

Electric Transfer Table.—A brief illustrated description of the one used by a Chicago traction company.—*West. Elec.*, June 17.

INSTALLATIONS, SYSTEMS AND APPLIANCES.

Municipal Lighting Stations.—An illustrated description of the Barking municipal plant is published in the London electrical journals of June 2. It is a small continuous current station of 120-kw, there being two dynamos of 80 and 20-kw respectively, the latter serving both as a balancing dynamo and for charging the accumulators, of which there are two sets of 127 cells each, having a capacity of 250 ampere hours.

Brighton Method of Charging.—BAUDRY.—A discussion of the Brighton system, otherwise known as the Wright maximum demand system.—BAUDRY. *L'Ind. Elec.*, May 25.

Alternating Current Systems of Distribution.—The first part of a long article describing and discussing the various systems of distribution of energy by alternating currents. In the present portion the Thomson-Houston system, the Steinmetz monocyclic system and the Schuckert systems are described with good diagrams, and discussed.—GUILBET. *L'Eclairage Elec.*, May 27.

Installation Accessories.—An illustrated article describing accessories such as the lamp bases, sockets, fuses, etc., adopted by the General Electric Co., of Berlin, for 250-volt incandescent light installations.—*Zeit. f. Beleucht*, May 20 and 30.

WIRES, WIRING AND CONDUITS.

Universal Wiring Chart.—FRY.—A chart enabling any of the four quantities involved in the calculation of wiring to be found without calculation, if the other three are known. In the use of the wiring formula there are four quantities involved; the cross-section, the length, the current, and the loss of potential. These four quantities are laid off as scales on the four sides of the chart, the scale of the cross-sections having also marked on it the B. & S. gauge numbers. There are a series of diagonals representing lines of equal resistance. To solve a problem the known values are followed along these scales and diagonals in a certain way, the reading on the final scale being the result sought for. The chart seems like others that have been devised, an apparent novelty consisting in the diagonals being broken lines owing to changes in the scales, so as to cover more conveniently certain ranges of values. The specific resistance assumed is 75 per cent. of that of pure copper, which seems rather low.—FRY. *Amer. Mach.*, June 22.

REFERENCES.

Standard Plug Contacts.—A description of the proposed standard plug contacts which have been suggested by a committee and are to be proposed for adoption at the next meeting of the Union of German Electricians. They are for connecting movable lamps or small motor leads to wall sockets, and are limited to currents from 2 to 6 amperes. The proposed dimensions seem to be those in general use in Germany.—*Elek. Zeit.*, June 1.

ELECTRO-PHYSICS AND MAGNETISM.

Luminosity or Rare Earths Produced by Cathode Rays.—A Royal Society paper by Mr. Swinton is reprinted in the Lond. *Elec. Rev.*, June 2. He describes experiments made with a number of the rare earths when heated in vacuum and by cathode rays, in endeavoring to explain certain actions of these oxides. He found that thoria and ceria both alone and mixed, behave quite differently when heated by cathode rays than when heated by a Bunsen flame. Incidentally it may be mentioned that a rough estimate of the amount of light showed that there were at least 150 candles per square inch of incandescent surface at an expenditure of approximately one watt per candle. The conditions of maximum luminosity, however, were exceedingly unstable.—SWINTON. Lond. *Elec. Rev.*, June 2.

Damp Coherers.—NEUGSCHWENDER.—An explanation of his anti-coherer, in which a film of moisture bridges the gap between metallic deposits. The increase of resistance due to electric waves takes place only when the moisture contains a salt which is capable of separating out a pure metal; phenomenon is therefore one of a metallic electro-deposit.—NEUGSCHWENDER.—*Wied. Ann.*, No. 5; abstracted briefly in Lond. *Elec.*, June 9.

REFERENCES.

Interference of Cathode Rays.—Descriptions of experiments by means of which the author endeavored to measure the speed of propagation of cathode rays. By one method he found it to be the hundred and fiftieth part of the speed of light and by another the three hundredth. He continues to maintain that cathode rays are longitudinal vibrations.—JAUMANN. *Sitz. Ber. Akad. Wissensch. Wein.*, 107, Part 2; abstracted, with illustrations, in the *Elek. Zeit.*, May 25.

Canal Rays.—Descriptions of an investigation made to study this phenomenon.—WEHNELT. *Wied. Ann.*, 67, page 421; abstracted with illustrations in *L'Eclairage Elec.*, May 27.

Röntgen Rays in Surgery.—A brief summary of recent progress in the application of Röntgen rays in surgery.—Lond. *Elec. Rev.*, June 2.

Photo-Electric Currents.—Descriptions of some investigations.—SCHMIDT. *Wied. Ann.*, April; abstracted briefly in *L'Eclairage Elec.*, May 27.

Theories of Atmospheric Electricity.—An abstract of a French Physical Society paper.—CHAUVEAU. *L'Eclairage Elec.*, May 27.

Change of Dimensions Due to Magnetism.—An article on the application of an interference method to the investigation of Young's modulus of wires and its relation to changes of temperature and magnetization; and a further application of the same method to the study of the change of dimensions of iron and steel wires by magnetization.—SHAKESPEAR. *Phil. Mag.*, June.

Zeeman Phenomenon.—An article on this phenomenon and on circular polarization and double magnetic refraction.—GOLDHAMMER. *Wied. Ann.*, March; abstracted in *L'Eclairage Elec.*, May 27.

Gold from Sea Water.—A note stating that a new process is being tried in London, invented by a German named Sauerwald. The process is especially adapted to be used in the condensers on board ship, and does not in any way interfere with the action of the condenser plant. The cost of extraction is estimated not to exceed 5 per cent. of the gold recovered, but the process is kept a secret. Promoters claim that there is good authority for believing that sea water contains 0.5 to 1 grain of gold to the ton, and they are estimating on recovering three-fourths of a grain per ton. The journal claims that this is obviously a rank imposture.—*Eng. and Min. Jour.*, June 10.

Pescetto Accumulator.—Some further statements by the makers are given in Lond. *Elec. Rev.*, June 2. It is claimed that the efficiency in energy keeps as low as 70 or 80 per cent., even when the cell is charged at as high a rate as 20 amperes per kg of plates, that is, when the duration of the charge is reduced to a few minutes, with a rate of discharge varying from 2 to 5 amperes per kg of plates. The result is claimed to be due to the excellence of the contacts and to the great permeability of the active material; the porosity, as was described in a previous abstract, is produced by adding to the oxides of the paste a certain quantity of ulmate of ulmine. A letter from a tramway company in Rome, where this accumulator is used, states that the 204 cells of this battery, which weighs about two tons, are adequate; that the duration of the charge on one line never exceeds four minutes, and that the mean consumption of energy per car km is about 600 watt-hours.—Lond. *Elec. Rev.*, June 2.

Primary Battery.—A form devised by Dr. Fontaine-Atgier is described and illustrated in the *Sc. Am. Sup.*, June 17, translated from *La Nature*. It is a single fluid cell with zinc as one element and rolls of wire cloth (but of what metal is not stated) as the other; the liquid is a solution of soda having a density of 36° B. The zinc is in the form of a hollow cylinder and the wire cloth rolls are placed both outside and inside of it; it is claimed that the wire cloth is an energetic depolarizer. The e. m. f. is said to be 0.45-volt. A battery having a capacity of 130.6 ampere hours weighed 13 pounds. When the wire cloth was covered with granulated manganese the e. m. f. was 1.54 volts. It is also claimed that the battery may be recharged like an accumulator. The retaining cell is of galvanized iron, and seems to be made the positive pole.—*Sc. Am. Sup.*, June 17.

REFERENCES.

Semi-Permeable Membranes.—Descriptions of some experiments with such membranes, which Ostwald claimed acted like an iron sieve; the present results do not accord with this idea.—MIJERS. *Rev. Tram. Chim.*, 17, p. 177; abstracted briefly in the Lond. *Elec. Rev.*, June 2.

Progress of Electrometallurgy.—An abstract from the *Rev. Industrielle des Mines* of an article giving a general review of the recent advances, including some data.—CHALON. *Eng. Mag.*, June.

Electroplating the Hulls of Vessels.—A brief illustrated description of the new system used by a New York company. Other descriptions of the earlier processes of that company have already been noticed.—*West. Elec.*, June 17.

UNITS, MEASUREMENTS AND INSTRUMENTS.

REFERENCES.

Meter.—The beginning of an illustrated description of the new self-winding energy meter of Aron-Aliamet.—*L'Elec.*, June 3.

Capacity Measurement of Long Submarine Cables.—A reply to the criticism of Dearlove in the discussion of Young's recent paper.—MURPHY. Lond. *Elec. Rev.*, June 2.

Large Static Machine for X-Ray Work.—An illustrated description of a machine having plates 6 feet in diameter.—WILLIAMS. *Sc. Am.*, June 17.

Magnetic Observations.—PRICE.—A short article on the observations made by the U. S. Government.—*West. Elec.*, June 17.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Protection of Telegraph and Telephone Lines by Fuses.—The recent rules of the German Government concerning the protection of such lines from circuits carrying strong currents, are noticed briefly in the *Elec. Anz.*, May 18. When overhead telegraph or telephone lines cross bare conductors, such as for electric railways or power transmission, or are near enough to get into contact with them, they must in future be protected with fuses. Telephone lines must have a double protection, a sensitive one and another less so, while telegraph lines need be protected only with the latter, which operate with about 2 to 3 amperes, although this is not sufficient protection to prevent the telegraph instruments from being ignited. The fuse wires run in glass tubes mounted on a porcelain plate. The less sensitive fuses are in all cases connected between the line and the lightning arrester; for overhead lines they are placed as near as possible to the opening in the wall through which the line enters a building; for underground lines they are placed between the cable and the lightning arrester. The sensitive fuses are connected with the lightning arrester; it seems that they consist of a nickelline wire 0.07-mm in diameter, 4-cm long. The lightning arresters, which are not provided with fusible coils, have coils of nickelline wire which with 0.22 amperes becomes so warm that they fuse an easily fusible alloy like Wood's, which in turn opens the circuit.—*Elek. Anz.*, May 18.

REFERENCES.

Submarine Telegraphs.—Reprints of some chronological statements which have been issued by the Treasury Bureau of Statistics, concerning the early work in connection with the Atlantic telegraph.—*Sc. Am.*, June 17.

Hughes' Experiments with Ether Telegraphy.—An illustrated description of the early experiments of Hughes noticed in the Digest, May 27.—MUNRO. Lond. *Elec. Rev.*, June 2.

MISCELLANEOUS.

Fusing Glass with Electric Heat.—The Becker method is briefly described and illustrated in *L'Eclairage Elec.*, May 27. The ground material falls down an inclined plane, and in doing so it passes in succession between three electric arcs, which fuses it, after which it runs into a crucible in which it is kept melted by a coal fire. It is claimed by the inventor that there would be an economy of three-fifths in the fuel formerly used. The time for producing fusion, which by the usual process is about 30 hours for 5000-kg of glass, would be reduced to a quarter of an hour.—*L'Eclairage Elec.*, May 27.

REFERENCES.

Electricity as a Factor in Modern Development.—A short article in which he shows what effect electric traction, lighting, power, telegraphy, telephony, etc., have had on modern development.—OWENS. *Cassier's Mag.*, June.

Biographical.—The second instalment of the biographical sketch of Lord Kelvin, including numerous portraits and many illustrations of his apparatus, laboratories, etc.—CORMACK. *Cassier's Mag.*, June.

Steering Torpedoes by Ether Rays.—A reprint of the article noticed in the Digest June 17.—*Elec. Rev.*, and *El'ty*, June 14.

Electrical Congress in Vienna.—The programme for a national congress which meets on June 14 to 17.—*Zeit. fuer Elek.*, May 21.

New Books.

MECHANICAL MOVEMENTS. A Treatise on Powers, Devices and Appliances Employed in Constructive and Operative Machinery and the Mechanical Arts. Edited by Gardner D. Hiscox, M. E. New York: Norman W. Henley & Co. 402 pages, 1649 illustrations. Price, $3.00.

This new work on illustrated mechanics, mechanical movements, devices and appliances covers nearly the whole range of the practical and inventive field, and is intended for the use of mechanics, inventors, engineers, draughtsmen and all others theoretically or practically interested in mechanics. As the author presents mechanical details by diagrams and illustrations of actual devices the work appeals directly to the eye and is undoubtedly an acceptable form of mechancal education that resorts to modern wants for the encouragement of inventive thoughts.

The book is divided into eighteen distinct sections in the order named: Mechanical Powers, Transmission of Power, Measurement of Power, Steam Power, Boiler and Adjuncts; Steam Appliances, Motive Power, Gas and Gasoline Engines, Hydraulic Power and Devices, Air Power Appliances, Electric Power and Construction, Navigation and Roads, Gearing, Motion and its Controlling Devices, Horological, Mining, Mill and Factory Appliances, Construction and Devices, Draughting Devices and Miscellaneous Devices.

Under each section are grouped numerous characteristic types, making the whole a very exhaustive and valuable collection of current engineering practice and a welcome acquisition to the technical library. The electrical section includes the description of fifty-six devices or principles which cover in a fair way each separate branch of the art. The author has not, however, done full justice to electrical engineering and some of his illustrations represent antiquated apparatus. This, however, detracts little from the great value of the treatise. The engravings are remarkably distinct, do not appear crowded and express volumes in themselves. The typography is excellent and the book has a comprehensive and well arranged index.

BOOKS RECEIVED.

LECONS SUR L'ELECTRICITE PROFESSEES A L'INSTITUT ELECTROTECHNIQUE MONTEFIORE. By Eric Gerard. Volume I. Sixth Edition. Paris: Gauthier-Villars et Fils. 819 pages, 338 illustrations. Price, 12 francs.

Integrating Wattmeters For Alternating Circuits.

THE Westinghouse Electric & Manufacturing Company has recently introduced several new types of integrating wattmeters. These wattmeters are designed for alternating current circuits, and are of the induction type. They are simple in design, and extremely accurate over a range extending from 2 per cent. of the full load to 50 per cent.

The case of this type of wattmeter is of ornamental design, the finish being black japan, and the edges, lettering and raised parts in polished nickel. The complete case consists of two cast metal parts, and with the joint sealed, thus making the wattmeter dust, bug and moisture proof, and thereby excluding from the mechanism three of the most important causes of inaccurate registration of integrating wattmeters. The meter and the terminals are sealed separately, enabling connection to the circuit to be made without any possibility of injuring the wattmeter parts.

Accuracy and permanency of calibration as well as mechanical excellence are made prime factors in the manufacture of these wattmeters. The greatest care is taken in their calibration, and in order that the operation of the instruments may be guaranteed each wattmeter is sealed and shipped in a separate box. When received they are ready for immediate installation without calibration or adjustment.

The simplicity and compact form of these wattmeters are the striking features. They are of the induction type, and require no electrical connections to the moving parts, thus doing away with brushes and moving contacts of all kinds. This extreme simplicity of mechanism insures reliability of operation, as it is well known that the use of commutators and brushes to convey even the smallest amount of current to the moving parts is a distinct and well recognized disadvantage. The moving element in the single-phase wattmeter is a single aluminum disc, which is supported by a very short stiff shaft, the whole being rigid and very light in weight. Great attention has been paid to this very important feature, since it has a most potent influence upon the performance, portability and life of the wattmeter. Fig. 4 shows clearly the simplicity of the revolving element. In the single-phase wattmeter this entire revolving element weighs only 15 grams—about ½ ounce—being so light that there is little or no chance of scratching or injuring the sapphire jewel by vibration or sudden jars. This desirable feature renders it unnecessary to resort to artificial, complicated and delicate devices to obviate injury to jewels necessarily resulting from the use of heavy revolving elements. It also allows the meter to respond immediately to sudden change or fluctuation of the load. Another important feature which has direct bearing on the wear

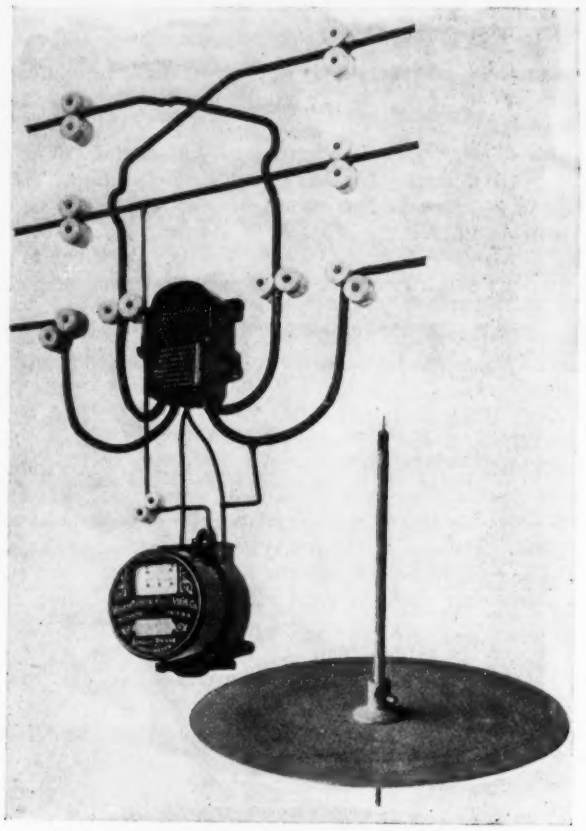


FIG. 1.—WATTMETER FOR THREE-WIRE SINGLE-PHASE CIRCUITS.
FIG. 2.—REVOLVING ELEMENT.

and consequent life of the meter is that the moving element makes but fifty revolutions per minute at full load.

These wattmeters register accurately the true energy of the circuit into which they are connected, under all conditions of non-inductive or inductive load, the registration being international watts. The law of operation of the meter practically insures absolute accuracy in registration throughout its entire range, which extends from 2 per cent. of full load to 50 per cent. overload. The accuracy on light loads is especially important, and is an extremely desirable feature which should not be overlooked. In almost all stations a large percentage of the total output is used to supply small loads which are usually but a small fraction of the full load capacity of the wattmeter installed. The Westinghouse wattmeters possessing a great overload capacity and giving accurate registration of this overload, make it practicable to install a wattmeter whose capacity corresponds to the average instead of the maximum load of the installation. The use of the smaller capacity wattmeter has an advantage in giving a better registration of light loads, and insures accurate registration on the smallest load which would be placed on the circuit. These wattmeters can be depended upon to commence recording when the load is one-half of one per cent. of their full capacity.

As an example, an installation having 240 100-volt, 12-cp lamps

connected would need a current of 120 amperes to supply all the lamps. The average load, however, would probably not exceed one-half the number of lamps installed. If the full number of lamps in the installation is seldom burning, and then only for a short time, an 80-ampere, 100-volt Westinghouse wattmeter will be the size of wattmeter to install, as it can safely carry 120 amperes and give accurate registration. The light load which would be carried for the greater part of the 24 hours, would be only a few lamps, possibly not over four 16-cp lamps (2 amperes). The 80-ampere wattmeter will give proper registration of this current, as it can be depended upon to give accurate account of 2 per cent. of its full load capacity, and will record the current accurately of 3 16-cp lamps. In other lamps, this wattmeter will give correct registration when but 1 per cent. of the total number of lamps installed are being burned.

The loss of energy in the wattmeter has received great attention. The shunt and series windings, and the mechanical features of the meter, have been specially studied to bring about an arrangement of windings and methods of adjustment to minimize these losses. The shunt windings are so well proportioned that the loss amounts to only 1.25 true watts; or in other words, the shunts of 40 of these meters will consume the same energy as one 16-cp. lamp. In the series coil the loss at full load is so slight that it can be detected only with the most delicate instruments. This feature of the wattmeter is of great value, as the loss due to series coils of meters is liable to be forgotten in station practice, but is nevertheless of considerable importance. In some cases, series coils containing many turns of wire have a loss of from 10 to 15 watts when the meter is fully loaded. Besides using up energy in the wattmeter itself, this causes a bad voltage drop in the circuit into which it is connected. It should be borne in mind that the series coil losses are greatest when the load on the station is at the maximum.

The light weight of the rotating element in these wattmeters, and the great care exercised in the construction of the recording movement, or counter, practically eliminates any losses from friction in the wattmeters.

Fig. 3 shows a single-phase integrating wattmeter. Its counter reads directly in watt hours, no constant or multiplier being necessary. A great variety of styles are manufactured to cover circuits of different alternations, current and voltage. With meters for

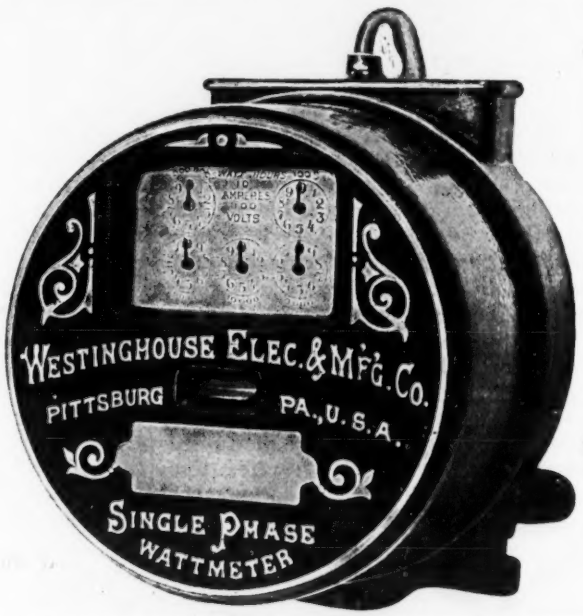


FIG. 3.—WATTMETER FOR SINGLE-PHASE ALTERNATING CURRENT.

large currents, and voltages less than 500 volts, series transformers are used; for voltages above 500 volts, both shunt and series transformers are supplied for all wattmeters.

Fig. 1 shows the integrating wattmeter for three-wire single-phase circuits. The wattmeter itself is identical with the two-wire single-phase wattmeter described above, and is made to register the energy delivered by a three-wire circuit through the medium of a specially designed series transformer, having two primary coils and one secondary coil. One of these primary coils is connected in series with one of the outer wires of the three-wire circuit, and the other primary coil connected in series with the other outer wire. The secondary coil, in which the current is proportioned to the sum of the currents in the two primary coils, is connected to the wattmeter. The shunt circuit of the meter is connected between the neutral and one of the outside wires. The counter records directly in watt-hours the total energy supplied to both sides of the three-wire installation, no multiplier or constant being necessary.

Fig. 4 shows the integrating wattmeter for polyphase circuits. This instrument records on a single dial the total energy delivered in the several two-phase or three-phase circuits. It will make a

FIG. 4.—WATTMETER FOR POLYPHASE CIRCUITS.

correct registration of the true energy delivered by the circuit into which it is connected under any conditions of power factor, whether the circuits are balanced or not. This is an advantage which is claimed not to be possessed by other meters now in use. The polyphase wattmeter possesses all the advantages and characteristics of the single-phase type, and is exceedingly small and compact, its over-all dimensions being 12x7½x½ inches. The counter records the total energy supplied in the several polyphase circuits in which the wattmeter is connected, no multiplier or constant being necessary.

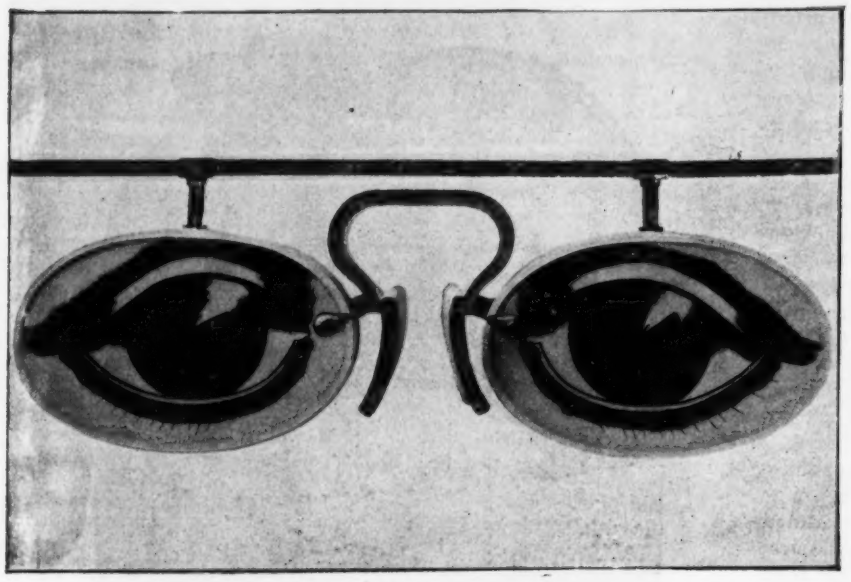
The Westinghouse Electric & Manufacturing Company claim for this line of integrating wattmeters, possessing as they do so many new and novel features, that they can not be surpassed for accuracy, permanency, compactness, durability, completeness, simplicity and perfection in both electrical and mechanical design.

A Novel Prismatic Electric Sign.

One of the most interesting decorative uses of the electric light has been its application to signs for ornamental and business purposes, a branch of work in which great ingenuity and inventiveness is now being shown. The Prismatic Electric Sign Company, of Williamsport, Pa., has struck out from the beaten path with great originality and is developing branches and fields of application far beyond those ordinarily exploited. It is a hackneyed fact that the incandescent lamp lends itself more readily than any other illuminant to advertising uses, but the designs of this company evince unusual fertility of resource and invention in the application of the idea.

We illustrate herewith a very clever and striking novelty just put upon the market by the Prismatic Electric Sign Company, which will serve to exemplify the beauty and utility of their work in general. It is intended to meet the demand from oculists, opticians and jewelers. These eyeglasses are 6 feet 6 inches long over all, the eyes being 26x18 inches. The frame and support are of

metal, the frames for the glass being finished in white enamel. The nosepiece and the spear are gold finished, and the supporting rod is black iron. The eyes are translucent and are fitted with a prismatic attachment which shows them in green, white and red, the colors changing color fifteen times per minute. The sign is provided with a cable for electrical connection to a mechanical motor contained in a cabinet located inside the building on which the eyeglasses are placed, and by a slight adjustment easily made, the effects can be varied, the eyes being made to blink, etc. The glasses may be suspended across the sidewalk, so as to show up and down the street, or can be put flat against the building.



A STRIKING ELECTRIC SIGN.

At night, when the sign is in operation, it can be seen very effectively for a distance of three blocks, while the amount of light necessary for full illumination is only four 16-cp. lamps. The sign is handsome to a degree, and it is good advertising in that it both attracts attention in a directly legitimate way and wins admiration for its ingenuity to the benefit of the man over whose store it hangs.

Telephone Equipment of University Club, N. Y.

Since it has become possible to buy telephone apparatus outright, there is hardly an institution of any magnitude that does not consider a complete telephone plant a necessity to its equipment. One of the finest and most elaborate systems of this character is that recently finished in the new University Club, Fifty-fourth Street and Fifth Avenue, New York City, by the Schmidt & Bruckner Electric Company, 135 Elm Street, New York. The system is of the automatic signal type. The removal of the receiver from the hook throws the line drop at the switchboard and on replacing it the clearing-out drop falls. The operator cannot restore the line drop until the plug is inserted in the correct jack, or the clearing out drop until this plug is withdrawn. Central batteries are used for talking and ringing purposes. The induction coils are also centralized.

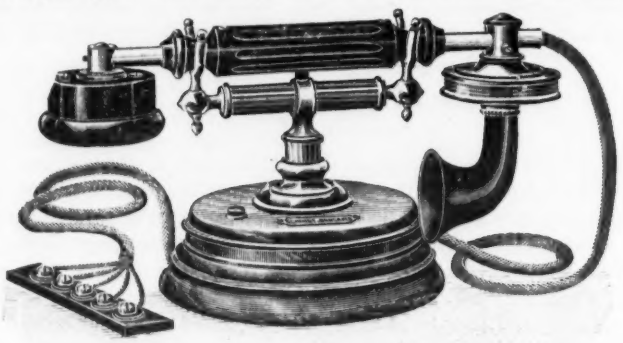


FIG. 1.—SPECIAL BEDROOM SET.

In each of the bedrooms and parlors is located a small white enameled box, on which is mounted a buzzer and a small stationary hook. The telephone proper is a combination "micro-telephone," with a clip on the handle. The clip is pressed down for calling and talking, and springs back when the pressure is removed, thus throwing the clearing-out drop. To the micro-telephone is attached an eight-foot cord. The other sets consist of small compact wall and portable desk telephones, finished in white enamel and various shades of oak, the metal parts being either of nickel or oxidized copper. The system comprises 80 stations.

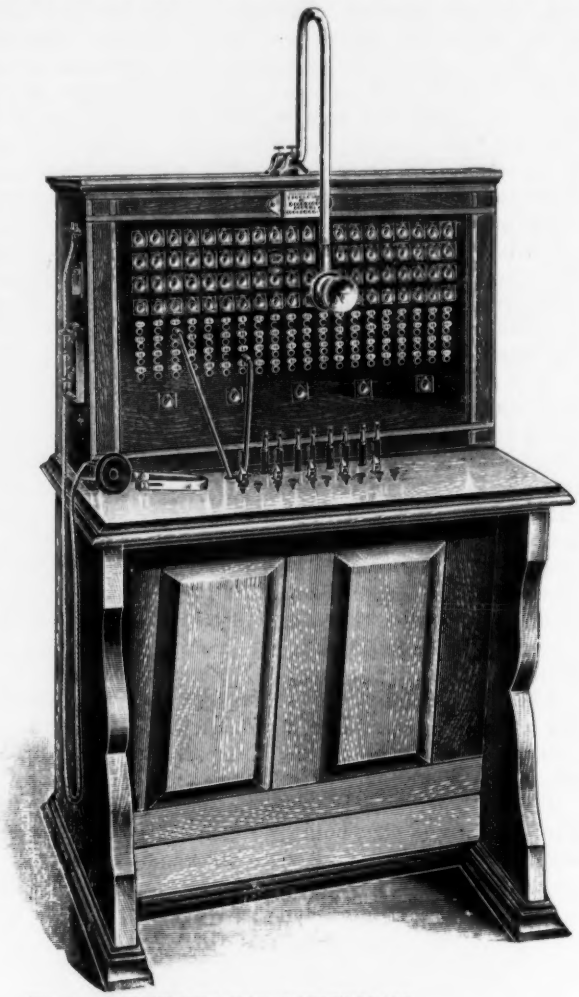


FIG. 2.—UNIVERSITY CLUB SWITCHBOARD.

The same company has a number of installations of this class in line which involve a great amount of special work. One of these is the equipment of the elevators of the Park Row Building, New York, with telephone connected to switchboards in the engine room. This service gives direct and instantaneous communication in case of trouble in the service of the elevators.

Sneak Current Arrester.

The device illustrated below is designed to protect telephone, telegraph and similar electrical apparatus from the evil effects of sneak currents. It is constructed on new lines and is claimed to be one of the most serviceable devices of its kind on the market. The heat coil springs out of circuit, leaving a gap of 1½ inches. The arrester is practically indestructible and can be used over and over again, thus reducing the cost of maintenance. In the illustration the arrester is shown both in its normal position and after having been warped by the effect of a sneak current.

SNEAK CURRENT ARRESTER.

These arresters, which are manufactured by the American Electric Telephone Company, Chicago, are mounted on iron cable terminals complete with carbon arrester. They are also mounted singly for the protection of station instruments. The device is named the Burns sneak current arrester, after Mr. P. C. Burns, president of the company.

The New Bullock Motor Factory, Cincinnati.

The new manufacturing plant of the Bullock Electric Manufacturing Company, Cincinnati, Ohio, is an admirable example of a modern industrial institution, embodying as it does the latest and best ideas as to economy of production; and every facility for good workmanship is supplied. This economy embraces not only the actual production of the goods manufactured by this company, but also takes into consideration the health and comfort of the employees.

The plant is located at East Norwood, Ohio, one of the suburbs of Cincinnati, where the Baltimore & Ohio Southwestern Railroad crosses the Pennsylvania lines, both roads having side tracks in the works, thus giving the Bullock Company excellent freight facilities.

The several buildings are constructed of light yellow pressed brick with appropriate trimmings of stone, and are well built. The plant comprises the administration building, machine shops, foundry and power house. In the first mentioned are the general offices, drafting and pattern rooms, lunch room for officers and heads of departments, with a completely equipped kitchen and pantry. In the main hall of the administration building is an office of the Postal Telegraph and Cable Company, with an operator in charge, and a telephone exchange extending to the various departments.

The drafting and pattern rooms are on the second floor of the building, and are very light and commodious for the large forces em-

OFFICES OF THE BULLOCK ELEC. MFG. CO.

ployed. To the practical man, however, the most interesting feature of the Bullock plant is the machine shop. Each machine has its own motor which furnishes power only when it is required. Among the machines equipped with electric power may be mentioned cranes, power presses, lathes, planers, drills, milling machines, profilers, emery grinders, hydraulic presses, boring mill, etc. The motors used for driving these various tools were especially designed and adapted for their particular duties, being built in the case of the lathes, directly in the headstock, and in other tools taking the place of the driving pulley and requiring no more room. The motors are of the slow speed type with the variable speed control, governed by the multiple voltage system, which permits the operation of the tools in six varying speeds in either direction, without the use of back gearing or any resistance whatsoever in the electrical circuits.

This application of motors to machine tools, although slightly more expensive in first cost than the use of line shafts, belting and counter shafts, soon justifies the additional expenditure, first, by the economy of power, due to the absence of long lines of shafting or belting to be driven, which are wasteful of power and are constantly needing repairs and attention; second, the output of the tool is increased, by reason of the variable speeds and the facilities of changing these speeds when the tool is in operation, and third, economy of space, since the tool can be located in any advantageous position without reference to line shafting, etc.

The departments in the machine shop embrace the winding room, where the armatures and fields of the machines are wound and carefully insulated, the coils of the armatures being machine formed before placed in slots of the armatures; the testing room, where the finished machine is tested to its fullest capacity during an entire day's run; the erecting shop, where the various parts of the machines are assembled and prepared for testing; the machine tool shop, where the raw material is converted into a finished product; the commutator and brass finishing shop, where the commutators are put together and where the brush holders, bushings and terminals are completed; the tool room, where the standard tools and dies are kept, and men

MACHINE SHOP.

employed in keeping them in repair and making new ones, and the stock room, filled with finished and raw material.

The power house is divided into three sections, i. e,. the boiler room, containing vertical water tube boilers, fitted with furnaces having moving chain grates; the engine room, with a cross-compound engine direct connected to two of the Bullock Manufacturing Company's engine-type generators, which supply current not only for the lighting system, but for the multiple-voltage power transmission used throughout the entire plant, and a section occupying the entire southerly end of the building, which is set apart and fitted out as the employees' lunch room. Apparatus for heating the gen-

ASSEMBLING SHOP.

eral machine shops is located in the basement of the power house, and hot air is conveyed thence underground to its destination. In the engine room an elaborate switchboard has been erected with the necessary electrical instruments and switches, including recording wattmeters registering the amount of power being used on the various circuits.

The next department is the brass foundry, where the company

makes all of its brass castings, and where the armature iron is annealed and japanned. Altogether the plant is a notable one, and one which is worthy of a visit from any manufacturer contemplating a change of power or material reconstruction of shops of any kind. Every machine employed is modern; every labor-saving device which could be profitably employed is there, and every economic problem has been carefully worked out. The logical result is a plant which is modern in every particular. The officers of the Bullock Electric Manufacturing Company are: George Bullock, president and treasurer; J. S. Neave, vice-president, and James Bullock, secretary.

Columbia Electrical Supply Company.

As another proof of prosperous times in the electrical industry we may refer to the auspicious opening of the Columbia Electrical Supply Company's new store at 93 Liberty street, New York, on Wednesday, June 21st. The new store is commodious, centrally located and in every way suited for their class of trade. It comprises three floors, which are well stocked with every conceivable part and appliance used in electric lighting and power generating and transmission. On the ground floor is the main store or salesroom, nicely fitted up with quartered oak counters, and fixtures in which are stocked bells, push buttons, wire cut-outs, etc., all arranged for expeditious handling by a large corps of able salesmen. In the rear we find the general officers', president's and treasurer's offices, also the office of the numerous outside salesmen who canvass the power plants and other users of material sold by the firm. In the basement and sub-basement are thousands of dollars worth of new and up-to-date material and supplies, waiting for shipment to the customers.

Messrs. Meikelham and Douglas, the pioneers of the Columbia Electrical Supply Company, are both Columbia college men and bring to their work not only business acumen but a sound professional training.

We are informed that the new company has opened a special department for repairs and breakdowns of electrical machinery, which is directly in its line of business and should be a boon to engineers and others in times of trouble. The Columbia Electrical Supply Company consists of T. M. R. Meikelham, president; W. B. Dinsmore, Jr., secretary; J. Sheap Douglas, treasurer; H. P. Douglas, vice-president. It is incorporated under the laws of New York State, and in addition to the above the various departments are in charge of such able men as C. H. Moulton, general sales; F. F. Hopper, incandescent lamps; power equipment and repairs, George Stanmore. Many of the competitors of this company were at the opening; also most of the prominent manufacturers' agents and salesmen in this city. The Columbia Electrical Manufacturing Company appears destined to achieve great success in its efforts to place before the public so large and varied a stock in such a convenient and commodious depot for electrical material, of every description.

Chains for Power Transmission, Elevating and Conveying Purposes.

The Aultman Company, of Canton, O., has recently placed on the market a very complete line of chains for the transmission of power and for elevating and conveying service, the salient features of which are strength, durability and moderate first cost. As will be seen from the accompanying illustrations, the side bars are interlocked with each other. The renewable wearing band or sleeve is socketed into the inner face of the side bar, but is entirely free to turn in the socket and around the bolt.

The working strain is borne largely by the wearing bands or sleeves instead of the bolts. The bolts are secured by a perfect nut lock and need not be riveted unless so desired. The links are thus well protected from dust and grit, but can be readily separated and uncoupled. The uncoupling can be done with the chain as tight on the wheels as it should ever run. Only moderate lubrication is needed, as the lubricant is in a great measure protected from dust and grit.

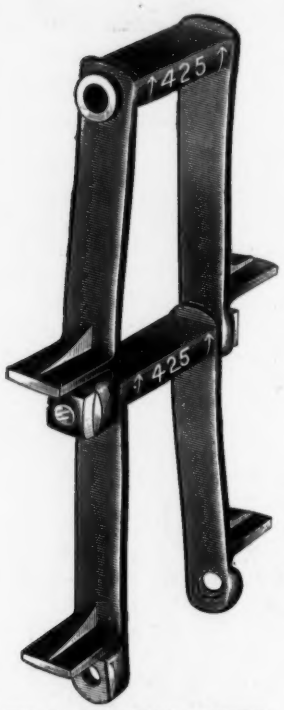


FIG. 1.—AULTMAN CONVEYING CHAIN.

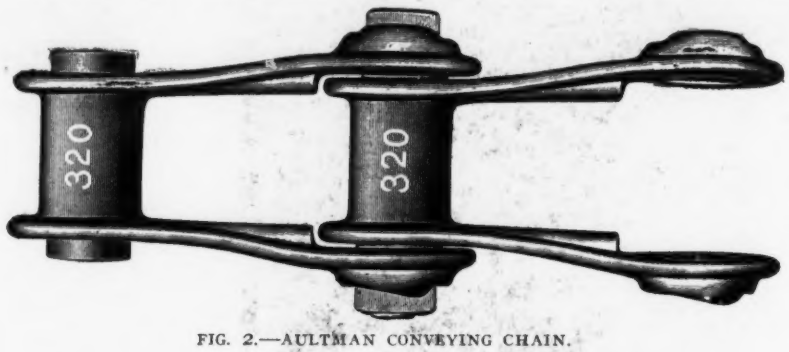


FIG. 2.—AULTMAN CONVEYING CHAIN.

FIG. 3.—SPROCKET WHEELS FOR CONVEYING CHAIN.

The different working strains for single strands are 3000 lbs., 7000 lbs., 3500 lbs., 9000 lbs., 12,000 lbs. and 10,000 lbs. For work requiring greater strength the chain can be worked in double strand. All standard or special attachment links are furnished with this chain.

Another class of interlocking chain belt is the pintle type as illustrated in Fig. 2. The construction and design of this chain gives the greatest wearing surface and strength with minimum weight. The wear is entirely on the cross bar and interlocking socket joints, which are practically dust proof. The chain articulates freely and easily, and is eminently well adapted for any purpose common to detachable chain belt. The construction allows the chain to be used with either side to the sprocket, or one side can be worn down and the chain reversed. The chain is made in all standard sizes and supplied with all standard attachments.

Sprocket wheels (Fig. 3) for the chains are made with chilled teeth, or of a semi-steel mixture where extra severe service is to be met; or the usual gray iron wheels can be used.

NEWS OF THE WEEK.

Financial Intelligence.

THE METROPOLITAN STREET RAILWAY COMPANY, of New York City, has declared a quarterly dividend of 1¾ per cent., payable July 15.

THE BOSTON ELECTRIC LIGHT COMPANY has declared its regular quarterly dividend of $1.50 per share, payable July 15, to stockholders of record June 30.

AMERICAN BELL TELEPHONE COMPANY.—The $2,000,000 American Bell Telephone 4 per cent., 10-year debenture bonds last issued, have been awarded to Estabrook & Co.

AMERICAN DISTRICT TELEGRAPH COMPANY, of Brooklyn, N. Y., is to hold a special meeting on July 11, to vote on a proposition to reduce its capital stock from $200,000 to $100,000.

WESTINGHOUSE DIVIDEND.—The Westinghouse Electric & Manufacturing Company has declared a quarterly dividend of 1¾ per cent. on the preferred stock, payable July 1. Books close June 24, open July 3.

TERRE HAUTE LIGHTS AND RAILWAYS.—The Terre Haute Electric Street Railway Company and the Citizens' Electric Light & Power Company plants have been sold to Stone & Webster, of Boston, for $560,000.

AMERICAN BELL TELEPHONE.—Directors of the American Bell Telephone Company have declared a regular quarterly dividend of 3 per cent. and 1½ per cent. extra. The dividend is payable July 15 to stock of record June 30.

CENTRAL & SOUTH AMERICAN TELEGRAPH COMPANY have declared a quarterly dividend of 1½ per cent., leaving a surplus of $491,465. The dividend takes $115,884, and the gross receipts for the three months were $234,943, the net being $86,000.

SOUTHERN TELEGRAPH & TELEPHONE COMPANY.—The Southern Telegraph & Telephone Company, operating in Texas and Arkansas, has just filed a certificate of an increase of its capital from five million to seven million dollars. The certificate states the debts and liabilities of the company amount to $900,000.

THE ELECTROLYTIC MARINE SALTS COMPANY.—The shareholders' committee of the Electrolytic Marine Salts Company has declared a dividend of 10 per cent. in liquidation, payable July 5, making 30 per cent. paid to that date. There will be a third and final dividend, bringing the total payments to about 35 per cent.

THE WISCONSIN TELEPHONE COMPANY has increased its capital stock from $1,200,000 to $3,000,000. General Thomas Sherwin, president of the New England Telephone Company, has been elected a director and member of the Executive Committee representing the interests of the American Bell Telephone Company.

MICHIGAN TELEPHONE.—At the annual meeting President Glidden stated that the company had gained 6088 subscribers net since Jan. 1, and had 5000 awaiting connection. The increase for the year will exceed 10,000. He saw no reason why the company should not earn 5 per cent. and leave a neat surplus after paying fixed charges. The stockholders approved 3000 miles of new pole line and 20,000 miles of long distance circuits.

WESTINGHOUSE ELECTRIC.—The strong financial position of the Westinghouse Electric Company is a matter of current comment in Boston. It is understood that the company is vigorously engaged in paying off all floating indebtedness and every obligation of whatever shape or kind. The company is on such a strong basis to-day that dividends on the common stock are a nearby probability, and a rate of 10 per cent. per annum would not surprise the friends of the company.

CHICAGO EDISON COMPANY, in its annual report, noted in our last issue, shows an equivalent of 489,583 lamps of 16-cp connected March 31. The gross income was $1,954,876, the expenses were $1,214,620 and the net was $740,255. Charges against income were $262,524, and dividends of $398,072 were paid. The storage battery installation is to be brought up to 6000-hp, the present equipment having been very successful. The controlled Commonwealth Company is more than earning its charges.

ELECTRIC COMPANY OF AMERICA.—It is the intention of the Electric Company of America management to begin regular dividends on the stock in July. The company is earning a dividend and one is to be declared to be followed at regular periods. A coming dividend will be declared on the basis of the amount paid in on the stock, which is $5 per share, and not on the basis of the par value, which is $50. There have been issued 500,000 shares of stock, representing $2,500,000 cash paid in capital.

NEW ENGLAND TELEPHONE STOCK.—Pursuant to a vote by the stockholders of the New England Telephone & Telegraph Co. increasing the capital stock from $12,000,000 to $15,000,000, the directors of the company have ordered that 9980 shares be offered to stockholders at par, $100. The issued capital now amounts to $11,976,000. Each stockholder of record at the close of business Monday, June 26, will be entitled to one new share for every 12 then held. The right to subscribe will expire July 22.

CHICAGO RAILWAY EARNINGS.—The Chicago City Railway's business for the first six months of the year is estimated to show an increase of 3,000,000 passengers over the same time last year, and the South Side Elevated a gain of 1,500,000 passengers, making an increase for the south side equal to 8½ per cent. On the west side, traction lines have carried 2,500,000 more passengers, the Metropolitan Elevated 2,000,000, and the Lake Street Elevated shows a good gain, making in all for the west division over 8½ per cent. On the north side the gain has not been so heavy, being about 3 per cent., or nearly 2,000,000 passengers.

CONSOLIDATION OF ST. LOUIS ROADS.—It is announced that, as Governor Stephens has signed the Street Railway bill, the negotiations for a general consolidation of all the street railroads of St. Louis, which have been in progress for some time, have been practically completed. The deal involves nearly $100,000,000. Brown Brothers, of New York, are said to be handling the financial end of the deal. Without the Suburban, which has not yet come into the combine, the Consolidated Company will have 295 miles of single track, and including the Suburban and new track to be constructed, they would have nearly 400 miles. Over $5,000,000 will be expended in improvements.

THE AMERICAN RAILWAYS DEAL.—It now turns out that the Philadelphia stories of a gigantic "trolley trust" have been exaggerations. The American Railways Company is not going to absorb the traction lines of New York, Philadelphia, Pittsburg and Chicago, but is only to take over the Consolidated Traction and Philadelphia Companies of Pittsburg, the latter including the United Traction Company. These concerns represent the electric lighting, natural gas and surface railway interests of Pittsburg, and, if the proposed deal is a success, the American Railways Company will be in control of all these. The understanding is that if the deals go through the American Railways Company will issue 5 per cent. collateral trust bonds in payment.

METROPOLITAN BUOYANT.—Metropolitan Street Railway's advance to 228¾ on Friday was one of the features of the market. About 6000 shares of the stock changed hands. Hints of pending developments were in circulation in explanation of Metropolitan's strength, and, although Wall Street in general regarded these intimations as referring to the rumored "melon cutting," people in touch with the company's affairs said that coming announcements will be of much greater importance. The story that Metropolitan interests are already in control of the Third Avenue system and are heavily interested in Brooklyn Rapid Transit receives no direct confirmation, but insiders do not deny that changes in the company's directories are impending. These changes, it is said, may make Mr. A. N. Brady a Metropolitan director and Mr. H. H. Vreeland a member of the Brooklyn Rapid Transit board.

METROPOLITAN PLANS.—It is stated that the Metropolitan Street Railway Company will lease to the New York Gas, Electric Light, Heat & Power Company, which it controls, all of its new subways and will also sell its surplus electric power to the same company. The contract will call for more than the mere surplus power, but this can be provided cheaply when the new power plant is in operation. The rental of the subways and the selling of the power will bring into the company about $2,050,000 annually. It is expected that the Metropolitan shareholders will be permitted to secure stock in the New York Gas, Electric Light, Heat & Power Company at a low rate, or it may be that the Metropolitan will hold this stock in its treasury and issue new Metropolitan stock to present holders to offset the new asset. In any case the Metropolitan will greatly benefit by the deal.

MASSACHUSETTS ELECTRIC COMPANIES.—Messrs. E. Rollins, Morse & Bro. and Messrs. Tucker, Anthony & Co. are offering to investors 70,000 of the preferred and 35,000 of the common shares of the Massachusetts Electric Companies in blocks of not less than two shares of preferred and one share of common on the basis of $210 for the three shares. The net income of these properties for the last completed fiscal year, after payment of interest on all bonded indebtedness, was $733,233; 4 per cent. on $12,000,000 preferred shares would be $480,000; 2 per cent. on $12,000,000 common shares would be $240,000, or $720,000. The dividends on the preferred shares are limited to 4 per cent. The management expects that the dividends on the common stock, owing to the increased business and economies of co-operative management, will average 4 per cent.

HOBOKEN (N. J.) LIGHTING DEAL.—The North River Light, Heat & Power Company, which has lately been trying unsuccessfully to secure firm foothold in Hoboken, has sold out, presumably to the Hudson County Gaslight Company, of Hoboken. It is understood that the Hudson County Gaslight Company will, in turn, be sold very soon to the North Hudson Light, Heat & Power Company, which is connected with the Shanley electric syndicate of New Jersey, and that in this way the last rival of the Shanley syndicate in Hudson County will be removed. The North Hudson Light, Heat & Power Company, of Hudson, is controlled by the Shanley capitalists, and the latter have lately been swallowing up one trolley company after another in northern New Jersey until, at the present time, the syndicate controls all the trolley lines in Hudson County, Essex County, Passaic County, and nearly all in Bergen County, Morris County and Union County.

THE WEEK IN STOCKS has been rather dull, as might be expected at this time of year, but the market is stronger, and the payment of dividends has left available a large sum for reinvestment. During the week 3285 shares of Western Union were sold, closing at 89¾. General Electric on dealings in 5275 shares fluctuated around 117½. Brooklyn Rapid Transit closed the week at 116⅝ on dealings in 150,000 shares. Metropolitan Street Railway closed as high as 228⅞. In Boston, American Bell Telephone sold up to 350 and Boston Elevated was 2 points lower, at 106. In New York, in the outside market, Electric Boat com. was 18 bid and 21½ asked; pref., 45 bid and 46 asked. Electric Vehicle com. was 100 bid and 103 asked; pref., 115 bid and 120 asked. General Elec. Automobile was 23 asked. General Carriage, 35 bid and 36½ asked. N. Y. Elec. Veh. Trans. was 24½ bid, and N. Y. Elec. Brake, 62½ and 64½ asked. N. Y. & N. J. Telephone was 180 bid, 190 asked.

ELECTRIC VEHICLE NOTES.—New York Electric Vehicle Transportation was active at the close of the week. The names of the new directors of the company helped to strengthen the market for the stock. Among the directors chosen are Henry Payne Whitney, E. D. Morgan, H. H. Vreeland, Martin Maloney, J. E. Hayes and James A. Stillman. Mr. Whitney was elected president and Mr. Morgan vice-president. Mr. Arthur Phillips, who has been secretary of the company for some time, remains in that office, and will act also as treasurer. Electric Vehicle common closed on Friday at 100 bid, and it was offered at 103. It is said that Mr. John Jacob Astor will probably take a place on the Board of Directors of the Electric Vehicle Company. Some of the recent buying of New England Electric Vehicle Transportation, as well, has been attributed to Mr. Astor, and before the names of the new directors of the New York Electric Vehicle Transportation Company were announced, it was thought that Mr. Astor would be one of them. It is now said that he will become a director of the parent company.

THE STATE OF TRADE.—In their weekly review of trade, Messrs. R. G. Dun & Co. say: "The outgo of more gold this week, $4,000,000 so far reported, makes it clear that Europe is in need. The French Ministerial crisis has been grave and prolonged, the collapse of German speculation in industrial stock threatens some trouble, but perhaps the South African uncertainty causes most disturbance. Whatever the cause, Europe needs money, and cannot claim its own from the West this year, but must borrow. Exchange and trade balances show that this country is not called upon to pay, but the money is worth more to lenders abroad than it is here. Home finances are most satisfactory. Revenue falls behind expenditures for the fiscal year less than $100,000,000, and but for $230,000,000 war expenses, including payment for the Philippine debts and for Cuban soldiers, the revenue exclusive of that from the war taxes exceeds ordinary expenses. Trade balances, in spite of exports from New York 19 per cent. less than last year's and imports 26 per cent. greater, still promise a large excess of exports for June. Nor is there any substance in the idea that large foreign sales of securities are moving gold. The best evidence attainable shows that in January and February about $8,250,000 worth of securities came to this side, and since February not more than $4,000,000 in excess of shipments. With nothing to fear in foreign affairs or finances, home business is expanding in every direction. The increase in volume of business shown by bank clearings is 42 per cent. for the week over last year, and 50 per cent. over 1892, and outside New York the increase over the best of all past years is 31.9 per cent. Moreover, this is in spite of a considerable decline in prices, which have not yet recovered to the level of 1892."

Special Correspondence.

NEW ENGLAND NOTES.

MR. A. H. COX, 60 Equitable Building, Boston, Mass., is now the New England salesman of the Fort Wayne Electric Works, of Fort Wayne, Ind.

STANDARD UNDERGROUND CABLE COMPANY of Pittsburg, Pa., will, it is said, secure a factory site on the Atlantic seaboard, with the object of engaging in the manufacture of deep sea cable such as that required for the Pacific, where an American cable is soon to be laid.

N. E. ELEC. SUPPLY ASSOCIATION has been formed in Boston on the same basis as the supply associations of New York, Philadelphia and other cities, to protect prices, credits, etc. Mr. C. B. Price, of Pettingell-Andrews Company, was elected president; Mr. J. H. Parker, of C. S. Knowles, vice-president; Mr. F. W. Cramphorn, of James W. Poole & Co., secretary and treasurer. It is proposed to have the association work in harmony with the other bodies by monthly meetings, etc., to discuss prices, agreements and other trade features.

THE RAILROAD COMMISSIONERS gave a hearing a few days ago on the petition of the Boston, Milton & Brockton Street Railway Company for an issue of $80,000 stock, as authorized under its charter, and the issue of $40,000 stock additional. The company's line will be 10 miles long. The company is under contract with the Massachusetts Electric Companies to transfer the property to it on completion. The power for the company will be supplied by the Hyde Park Electric Light Company, which is owned by the Massachusetts Electric Companies. The hearing was continued pending an appraisal of the property.

NEW YORK NOTES.

THE PROSPECT PARK & CONEY ISLAND RAILWAY COMPANY has been leased by the Brooklyn Heights Railway Company. Possession was taken at midnight Saturday, June 17. Mr. Ira A. McCormack was appointed general superintendent in charge of operation, and Mr. J. C. Brackenridge was appointed chief engineer in charge of maintenance of way, buildings and construction.

THE AUTOMOBILE COMPANY OF AMERICA, with headquarters in this city, has been chartered in West Virginia. The purposes of the company are to manufacture automobiles, autotrucks and horseless carriages. The capital subscribed is $20,000, with the privilege of increasing it to $2,500,000. The shares are $100 each, and are held by Avery D. Andrews, of New York City; Amzi L. Barber, of Ardsley; Lewis A. Beebe, of Dobbs Ferry; Newton C. Lyon, of Montclair, N. J., and L. D. L. Barber, of Ardsley, N. Y.

THE MUNICIPAL OWNERSHIP COMMISSION of the Common Council of Syracuse, N. Y., will this week visit, for investigation in connection with that subject, the larger municipal lighting plants of the country. The commission comprises Mayor McGuire, President Mack and Aldermen Kearney, Kruger and Reagan of the Council. Mr. L. W. Emerick, electrical engineer, accompanies them as expert in connection with the technical part of their work. Their route includes the cities of Pittsburg and Allegheny, Chicago, Detroit and others to be determined. The project of municipal ownership is strongly supported by the present city administration.

ELEVATED RAILWAYS AT AUCTION.—At noon on July 6 the Kings County and Fulton Elevated Railways will be sold in foreclosure proceedings in pursuance of a judgment granted by the Supreme Court to the Mercantile & Central Trust Companies of Manhattan. Bids for less than $1,750,000 will not be accepted, and bidders must deposit with the referee $175,000 in cash or by certified check, or, in lieu thereof, $350,000 in bonds secured by the mortgage or deed of trust foreclosed in the action. With interest from May 24, 1899, together with cost, the approximate amount of the lien or charge, to satisfy which the property is to be sold, is $3,933,812.92. Other liens due on certificates issued by the receiver amount to $300,000.

AUTOMOBILES IN THE PARKS.—It is stated that the owners of automobile vehicles in this city have decided to take concerted action to induce the Park Board to rescind the rule excluding automobiles from the Central Park drives. Application for permits to enter the park have been made by individual owners of automobiles from time to time, but all have been refused by the commissioners on the ground that the drives are already crowded and that automobiles frighten horses and endanger life. The owners of these vehicles claim that they have a right to go where other pleasure vehicles are permitted, and add that if horses so spirited as to be difficult to control are driven in the park, it is such horses and not the automobiles tnat should be excluded in the interest of public safety.

THE NEW YORK & LONG ISLAND TERMINAL COMPANY, which proposes to operate an electric railroad in a tunnel under the East River, was incorporated at Albany on June 20, with a capital of $7,500,000. The road is to extend from Flatbush and Atlantic Avenues, Brooklyn, to a point west of Broadway and south of Fulton Street, in Manhattan Borough. The directors are Charles M. Pratt, Eugene G. Blackford, William H. Baldwin, Jr., Lowell M. Palmer, George D. Pratt, Frank L. Babbatt, of Brooklyn; George W. Young, Lewis Cass Ledyard, Richard A. McCurdy, Walter G. Oakman, R. Somers Hayes, James Timpson, August Belmont, Frederick G. Bourne, Chas. D. Dickey, C. Ledyard Blair, Henry P. Booth, James S. Auerbach, of New York City; John J. Waterbury, of Morristown, N. J., and Dumont Clarke, of Schraalenburg, N. J.

PITTSBURG NOTES.

MR. MORRIS MEAD, the chief of the local municipal department of electricity, during the last few days has been entertaining a number of Cincinnati officials by showing them the electrical equipment of the police and fire alarm offices in this city. The visitors were Messrs. John Archibald, Louis Roehl, W. F. Perkins and William Rieker.

ANOTHER BIG DEAL has been negotiated, and is about to be closed in this city. This is the consolidation into one concern of all the electric light and electric street car companies into one corporation, which has been effected by the Philadelphia Company offering to buy the Consolidated Traction Company of Pittsburg. The Philadelphia Company was until recently controlled by Mr. Westinghouse, who, however, sold it to a syndicate headed by Brown & Co., the Baltimore bankers. The Philadelphia Company controls the lighting of the city by electricity, and also the furnishing of natural gas for illuminating and heating purposes. This company also acquired the United Traction Company some time ago, which represented one part of the street car interests of Pittsburg and Allegheny. By the purchase of the Consolidated Company the Philadelphia Company will have practically a monopoly of all the street car lines in Allegheny County, forming one of the largest systems of electric traction in this country.

OHIO NOTES.

THE TOLEDO & OTTAWA BEACH ELECTRIC RAILWAY and the Detroit & Shore Line, both of which are under construction, have consolidated under one management, at the head of which is C. N. Haskell, of Toledo. Both lines will be in operation before the end of the summer.

THE LORAIN COUNTY RAILWAY COMPANY has secured right of way for a new electric road from Elyria to North Amherst. The idea is to connect Elyria with Lorain by the way of North Amherst, but the company has been unable to secure a franchise from the Lorain council. The first mentioned part of the road will be built at once.

A 99-YEAR RAILWAY FRANCHISE.—The Ashtabula County Commissioners have granted a 99-year franchise to the Burton, Jefferson & Andover Electric Railway Company for a line from Burton, Geauga County, via Windsor, Orrwell, Rome, to New Lyme, thence north through Lenox to Jefferson and east from New Lyme through Cherry Valley to Andover. The proposed line traverses a wealthy farming country.

RAILWAY FRANCHISE GRANTED.—The Jefferson County Commissioners have granted a franchise to the Burton, Jefferson & Andover Electric Railway Company to build a cross-country line between the towns mentioned. The life of the franchise is 99 years. The commissioners reserve the right to name such conditions as the public interests demand. The project is a continuation of the Cleveland & Burton line, and is designed to eventually reach Conneaut, Ashtabula and Geneva.

THE CLEVELAND & CHAGRIN FALLS RAILWAY COMPANY has been bought by a syndicate of Cleveland people, including M. G. Watterson, A. G. Hutchinson, James R. Sprankle, F. M. Walworth and George H. Foote. At a recent meeting of the new owners the following officers were elected: F. M. Stearns, president; M. G. Watterson, vice-president; A. G. Hutchinson, secretary, and C. E. Morganthaler, treasurer. An extension of the road from Chagrin Falls to Garretsville is under way and will be completed in the near future. The road will be 40 miles in length when fully completed.

THE CLEVELAND STREET RAILWAY STRIKE.—The 1000 employees of the 15 lines of the Cleveland Electric Railway Company, which struck work on June 10, have settled their differences with the company and went back to work on June 25.

ELECTRIC TRACTION ON STEAM RAILWAY.—The Wheeling & Lake Erie Railway Company is preparing to alter its line from Wheeling to Steubenville so that trains may be operated by electricity instead of steam. That section of the road will be double-tracked, using steam on one track for freight and electricity on the other for passengers. The main line terminates at Warrentown, half-way between Steubenville and Wheeling, and there all steam passenger traffic will end. A traffic arrangement has been entered into with the Steubenville Traction Company, whereby this road will carry Wheeling and Lake Erie passengers until the latter's electric line is completed.

SUIT TO DISSOLVE AN ELECTRIC TRUST.—Marcus Bartlett, of Cleveland, doing business as the Bartlett Electric Company, has brought suit to dissolve what he claims to be an electrical trust. The defendants are the Electric Supply Manufacturing Company, the Dainz Electric Company, the Euclid Avenue Electric Company, the Time Electric Company, A. E. Moses and Charles Bateson, doing business under their own names, and George H. Gleason, president of Union No. 38, of the National Brotherhood of Electrical Workers of America. Bartlett claims that the defendants conspired together to ruin his business, and that the association is in violation to the laws of Ohio, being a trust. He asks that the defendants be restrained from maintaining the association and that he be allowed damages for lost business.

INDIANA NOTES.

EXTENSION ORDERED.—The Indianapolis Street Railway Company has been directed by the city, under authority of the new charter, to extend its line to Tenth Street east to Only Street, thence north on Only Street to Sixteenth and Brookside Park.

A 50-YEAR FRANCHISE GRANTED.—At a meeting of the Town Council of Mooresville on June 6, a 50-year franchise was granted to the Indianapolis & Martinsville Electric Railway Company, giving the company the use of two streets. The company promises to build a line from Mooresville to Monrovia Hall and Eminence, a distance of 20 miles.

RAILWAY DEAL CLOSED.—General Manager James R. Henry, of the Union Traction Company, of Anderson, and George C. McCullough, of Muncie, have closed the deal for the Marion Street Railway. It will be made part of the Union Traction System, and the line will be increased to a length of nearly 100 miles. New officers were elected as follows: President, C. L. Henry; vice-president, Philip Matter; secretary, George McCullough; treasurer, William C. Sampson.

UNION TRACTION COMPANY'S IMPROVEMENTS.—General Managers Henry and McCullough, of the Anderson & Muncie Street Railway systems, announce the purpose of expending $50,000 for the improvements of the line. The plan is to reduce the time schedule between the two points—36 miles—to one hour and a quarter. A portion of the track will be doubled. The work on the line from Anderson to Muncie was begun on June 26, and cars will be running by December. It is given out that the Muncie system will ultimately be merged into the Union Traction Company system. The Elwood extension of the interurban from Anderson via Alexandria has been opened.

BROAD RIPPLE ROAD TO BE SOLD JULY 17.—After a prolonged argument by the attorneys on the intervening petition of the State Street Trust Company, of Boston, trustees for holders of $400,000 bonds of the Indianapolis & Broad Ripple Rapid Transit Company, asking for the foreclosure of the mortgage securing the bonds and for the immediate sale of the road, free from the liens against it, Judge Carter, of the Superior Court, Indianapolis, ordered the sale of the property set out in the petition on July 17. The terms are $25,000 cash and the balance in four, eight and twelve months, with interest. Bidders must deposit certified checks for $10,000. A condition of the sale is that if there is failure to make any of the deferred payments, the receiver will again take possession of the road.

NEW ELECTRIC RAILWAY COMPANY.—The Kokomo, Wabash & Northern Railway Company has been organized to construct an electric line between Wabash and Kokomo. It is composed of business men of Wabash, Kokomo, Greentown and Converse. The capital has been fixed at $300,000. The distance between the termini, as surveyed, is 36 miles. The estimated cost of construction and equipment is $300,000, and assurances have been given that subsidies will be voted by the people in the three counties traversed. Power houses will be erected at points where natural gas is in abundance. The directors of the company are R. F. Lutz, James Lynn, J. R. Bruner, Warren Bigler, Scott Davis and Rosco Kimble and others. Some of the parties behind this scheme have also made a survey of a trolley line to connect North Manchester and Warsaw. They are believed to be working in the interest of the Indiana electric railway companies which own the Elkhart, South Bend and Goshen systems and connecting interurban lines reaching to Chicago, and which is projecting a line from Goshen to Wawasee and Warsaw, both noted summer resorts.

CHICAGO NOTES.

THE AARON ELECTRIC COMPANY, Chicago, has just added a number of new machines to its plant for repairing dynamos and motors and rewinding armatures. This company has also been appointed general agent for the Eagle motors.

MR. DEWEY NEWMAN, representative of the Illinois Electric Company, Chicago, has just returned to the city after a six weeks' trip through Indiana and Illinois, which was unusually successful. He reports that the outlook for business in the electrical supply line in this section of the country for the coming fall is particularly bright.

PULLMAN STREET RAILWAY CARS FOR SOUTH AMERICA.—The Pullman Palace Car Company has received a large order from Chevalier Boutelle, who represents large railway interests in the Argentine Republic. The order is for cars and coaches and includes some street railway cars for Buenos Ayres. It amounts to $5,000,000. The street railway cars are to be equipped with American apparatus.

ELECTRICAL CABS IN CHICAGO.—Subscriptions for stock of the Illinois Electrical Vehicle Company, which is to operate an electric cab service in Chicago on lines which have been adopted in London and New York, have finally been opened. It is proposed at this time to underwrite $20,000,000 of the authorized $25,000,000 stock. Of the issue $10,000,000 will go to New York, Boston and Philadelphia interests, and the remaining $10,000,000 will be offered in Chicago. The eastern allotment has been practically taken, and Chicagoans have already put their names down for a large part of the amount reserved for this city. Samuel Insull, president of the company, is in charge of the underwriting. The stock will not be publicly offered. While the par value of the shares is $100, an instalment of but $5 will be called for at the start. Official announcement has been made that the company had been completed. The directorate of the company will consist of 11 men, as follows: Chicago—Samuel Insull, president; John J. Mitchell, Edward L. Brewster, C. K. K. Billings, C. F. Kimball, Levy Mayer, and R. T. Lincoln. Eastern—J. S. Hayes, of New Jersey, counsel for the Electric Vehicle Company; P. A. & B. Widener, Martin Maloney, and H. P. Whitney.

MINNESOTA NOTES.

THE MANKATO ELECTRIC STREET RAILWAY, LIGHTING & POWER COMPANY has lately been incorporated. The capital stock is about $500,000. Mr. Leo S. Lamm is president, and Mr. S. Wilhartz, secretary of the company, with offices at Mankato, Minn. The company has already obtained a franchise from the city of Mankato, purchased a local linseed oil company's plant, which is to be used as far as possible as a power house, and bought 25 miles of right of way out into the country in order to connect several small towns, which have no railroad connections, to Mankato. Messrs. W. I. Gray & Co., of Minneapolis, have been engaged as consulting engineers.

THE NORTH WESTERN TELEPHONE EXCHANGE COMPANY is making extensive improvements in St. Paul and Minneapolis. The St. Paul division is to have a new exchange building and switchboard. The latter will be installed by the Western Electric Company, and will have a capacity of 5000 circuits. The resistance of all circuits has been measured and a condenser put in in each subscriber's circuit so that the relay system can be used. As soon as the new switchboard is installed each subscriber will be supplied with a new telephone. Four thousand new telephones were lately shipped to this company by the American Bell Company, of Boston. This is the largest single shipment of telephones ever made. New buildings for sub-exchanges are being built in both cities. The cost of the improvements in the Twin Cities by this company will amount to about a quarter of a million dollars.

THE MISSISSIPPI VALLEY TELEPHONE COMPANY, which is owned by J. C. Hubinger, has 500 men at work on its lines and exchanges in St. Paul and Minneapolis. About a million and a half dollars are expected to be expended before the work is completed. The underground construction in both cities, 72 trunk lines between St. Paul and Minneapolis, and wiring and instruments for 3000 subscribers are ready for operation. The Stromberg-Carlson Telephone Manufacturing Company will furnish instruments and multiple switchboards. The central-energy system will be used. The company has already contracted with 5500 subscribers at the following rate: Long distance instruments, full metallic lines, unlimited service at $4.00 per month for business houses and the same service at $2.50 for residences; no other rates offered. Mr. D. R. Craig, secretary of the company, expects everything to be in running order by July 15.

SOUTHERN NOTES.

RALEIGH, N. C.—Senator Cameron, of Pennsylvania, is the head of a large syndicate which is being formed to develop the water power at Roanoke Rapids in this State, and to establish a large electrical transmission plant there.

THE MONTGOMERY WATER POWER COMPANY has been organized in Jersey City with a capital stock of $600,000. The incorporators are Charles W. King, William Clarke and R. Vanderhoof of Jersey City, but these are only agents for the real electric light and power plants all over the South, especially in Alabama, where the manufacturing industries are to receive a boom through this new company. The current is to be generated by water power.

ST. LOUIS NOTES.

CITY HALL LIGHTING.—The Board of Public Improvements is discussing the advisability of establishing an electric plant in the City Hall for the purpose of supplying the building with light.

NEW MOTIVE POWER.—Immediate steps will be taken to change the motive power of the Fourth and Olive Streets line to a modern electric equipment, and otherwise improve the roads. The changes will be inaugurated as soon as the material can be secured. Most of the material has already been ordered.

THE DEAL for the purchase of the lines of the National Street railway and the Southern Electric line by Brown Bros. & Co. is said to be practically completed. The lines will pass into the hands of Brown Bros. within the next 30 days. No figures are given in the deal. The National Railway Company includes the Citizens', the Northern Central, the Union, the Broadway Cable, the Cass Avenue and Fair Grounds and the Southwestern and extensions. With the Northern and Southern Electric lines the roads owned by Brown Bros.

will include all the lines of the Lindell Railway system, the Scullin or Union Depot system, the Missouri system. Brown Bros. will, therefore, own every street car line in St. Louis, with the exception of the Suburban. It is said that they will also buy the latter road. Now that the street railway consolidation bill has been signed by the Governor, consolidation plans will be pushed. A new company will be formed to take in all the others. There will be but one set of officers and one Board of Directors.

STREET RAILWAY BILL SIGNED.—Governor Stephens, on June 19, signed the bill recently passed by the Legislature, permitting street railways to consolidate. The signing of this bill will be very important to the public. First the Fourth Street or People's system will be changed to an electric road; the old road will be abandoned and a new road built in its stead. There will be a big improvement in street car facilities and the expenditure of a large sum of money for labor and material. It will also result in the removal of the present power houses from their central location to the remoter limits of the city. The power house of the People's Company and that of the Union Depot will be dismantled and the power supplied from the Lindell station and another station to be constructed. It is also proposed to inaugurate a system of transfers. Already orders have been placed for 250 new car equipments, and it is estimated that improvements to be immediately undertaken will involve an expenditure of not less than $5,000,000. When all these things have been done the street car service of St. Louis will be unsurpassed in the world. The work will be put under way at once and pushed to completion.

TEXAS NOTES.

MR. J. G. WESSENDORF, of Bellville, Tex., is organizing a company to construct an electric light and power plant for that town. Almost sufficient capital has been subscribed.

THE MOUNT VERNON ELECTRIC LIGHT COMPANY, of Mount Vernon, Texas, has been organized for the purpose of establishing an electric light plant in that town. Mr. R. A. Day is president; Mr. J. H. Gordon, vice-president, and Mr. T. B. Bannister, secretary and treasurer.

ELECTRIC RAILWAY FOR ALVIN, TEX.—A company of Kansas City, Mo., capitalists has been organized for the purpose of constructing and operating an electric street railway at Alvin, Tex. This town is about midway between Galveston and Houston, and is having a rapid and prosperous growth.

THE LONG PENDING DECISION of Judge Morgan, of the Dallas, Tex., District Court, in the injunction case of the Standard Electric Light & Power Company against the Dallas Electric Company and the city of Dallas, has just been rendered. His decision is in favor of the plaintiff company and prohibits the Dallas Electric Company from lighting the streets and public buildings of the city under a contract which the Standard Electric Light & Power Company contends is illegal. The decision also prohibits the city of Dallas from paying to the Dallas Electric Company any moneys under the contract.

PACIFIC COAST NOTES.

ELECTRIC POWER FOR THE COMSTOCK MINES.—The principal details of an electric power plant to supply the Comstock mines in Virginia City, Nevada, with cheap power, have been decided upon. The work of pumping out the flooded levels of the Comstock is progressing favorably. Water power will be utilized.

THE MARKET STREET RAILWAY COMPANY, San Francisco, seems likely to obtain the additional franchises petitioned for, as the Street Committee of the Board of Supervisors has reported favorably. There has been much opposition to the franchises at certain points. The general offices of the company have been moved to 49 Second Street.

AUTOMOBILES IN SAN FRANCISCO.—Active preparations are being made for the introduction of automobile vehicles in San Francisco. Freight transferring to and from business houses and parcel delivery will be important features of the proposed service by the local company. The business will be conducted as a branch of a large Eastern company.

CANADIAN NOTES.

THE STILL MOTOR COMPANY, of Toronto, Ont., has been granted provincial incorporation, with a capital of $75,000, to manufacture batteries and other appliances for propelling carriages, street cars, etc. The provisional directors are W. J. Still, Thomas Bengough, L. W. Doran, C. W. Chadwick and Joseph Heighton.

THE DOMINION GOVERNMENT will grant a subsidy for the electric railway from the city of London, Ont., to Goderich, Ont. The proposed road will be 66 miles long, running through Lucan, Crediton and Bayfield, and other points not now provided with railway service, The line is to be constructed for either steam or electric power.

PROJECTED ELECTRIC RAILWAY.—It is said that there is a third projected electric railway from the city of Hamilton, Ont., to Guelph, and is being promoted by Engineer E. B. Wingate, formerly of the Toronto, Hamilton & Beamsville Railway, and H. Carscallen, M. P. P. The other two electric railway lines on paper are the International Radial Electric Railway and the Hamilton Radial Electric Railway.

THE CANADIAN GENERAL ELECTRIC COMPANY is offering a series alternating arc lighting system to its patrons. It is thought that this system will tend to revolutionize the systems now in use in Canada for street lighting. Appreciating the advantages to be obtained, the Sherbrooke Gas & Water Company, of Sherbrooke, Que., has placed an order with the Canadian General Electric Company for a complete equipment of 100 of these lamps, with transformers.

A LARGE RAILWAY DEAL.—It is stated on good authority that the Patterson syndicate has secured full control of the Hamilton (Ont.) Electric Street Railway, and that the big scheme of building electric railways to Guelph, Galt, Berlin and the Falls, as well as running the street railway, Radial Railway and Hamilton & Dundas Railway under one management, is now certain to be consummated within a year. The terms of the latest bargain are being kept a secret, but there seems to be no doubt that the Cataract Power Company has obtained ownership of the electric street railway.

DIVING BELL SIGNAL SYSTEM.—Mr. T. A. Smith, district superintendent of the Bell Telephone Company, at Kingston, Ont., has invented special instruments of unique design for communication between the workmen on the surface and the divers at the bottom of the river, while they are engaged in the work of raising the Cornwall bridge, across the St. Lawrence, at Cornwall, Ont. The ordinary diving apparatus has been dispensed with and supplemented by special diving bells, so constructed as to withstand the pressure of the water. They are also protected by heavy metal shields. The telephone is put inside the bell, and electric alarms give the signal when either party desires to converse.

FRAZIL ICE.—The Lachine Rapids Hydraulic Company, of Montreal, has been fighting the frazil, or anchor ice, problem more or less continuously during the whole period of its existence, but only recently was a discovery made which, Mr. Lea Walbank, the managing director, claims, will obviate all future difficulties from this source. Near the mouth of the intake, it seems, there is a 14-foot rise in the bed of the river, which forms a natural dam, and which has prevented the working out of many attempts to do away with the frazil. To get still water just where the company requires it, a dam is to be constructed from the intake of the present head-race out to the natural shoal. About 1000 feet of crib-work is also to be built and 25,000 feet excavated from the reef. To provide against all emergencies a steam plant is to be installed to safeguard the company's customers.

TO DEVELOP A WATER POWER.—For some months past it has been reported that the water power at Fenelon Falls, Ont., was to be developed for the purpose of transmitting electric power to Lindsay, Ont., a distance of 14 miles. It is now stated that the undertaking has been definitely decided upon by the Light, Heat & Power Company, of Lindsay, which expects to have the new plant in operation by the first of October next. The company has commenced the work of construction and is arranging plans for the development of about 1200-hp. The electric plant will eventually consist of two 400-kw, three-phase generators, direct coupled to turbines. The company has placed an order with the Canadian General Electric Company for one 400-kw generator, together with switchboards, step-up and step-down transformers, and all the apparatus required to complete the electrical installation.

General News.

THE TELEGRAPH AND TELEPHONE.

CARTHAGE, MO.—The Carthage Telephone Company was sold to Eastern capitalists for $9000 cash.

SEDALIA, MO.—A telephone line is being constructed between this place and Longwood by Contractor E. R. Ballard.

BURLINGTON JUNCTION, MO.—Messrs. H. C. Todd & Co. have installed a new telephone exchange in this place.

FRANKFORT, KY.—The Carrollton Telephone Exchange Company, of Carroll County, has been incorporated, with a capital stock of $5000. R. M. Parker is one of the incorporators.

DILLER, NEB.—The Diller Telephone Company has been organized here, with a capital stock of $1000. The incorporators are E. L. Osborne, T. P. Price, T. Nelson, J. A. Price, all of Diller.

NEW HAVEN, CONN.—The bill to incorporate the Boston & New York Telephone Company has been defeated in the State House of Representatives. If the company organizes it must do so under the new general telephone act.

SANDSTONE, MINN.—Permission has been granted to the Long Distance Telephone Company, which is now building its lines from St. Paul to Duluth, to run the same through this place. A local exchange will be put into operation.

ERIE TELEPHONE.—Mr. Nestor, chief contract agent of the Erie system, secured 1649 contracts in 25 days in Milwaukee. When all are connected Milwaukee will have 5331 subscribers; the canvass will continue until 10,000 subscribers are connected.

MARYSVILLE, OHIO.—The Central Union Telephone Company has made arrangements to build a new toll line between this city and Urbana. The old line is being replaced with a double copper metallic line. The line runs through Milford Station and Mechanicsburg.

FAYETTE, OHIO.—The Fayette Telephone Company has been organized to construct and maintain a telephone exchange in Fayette. The capital stock is $10,000, and the incorporators are A. J. Venier, F. W. Wood, G. H. Probst and Hattie J. Venier, all of Fayette.

DULUTH, MINN.—The Duluth Telephone Exchange Company is the title of a new company recently organized here, with a capital stock of $500,000, for the purpose of operating telephone lines. The incorporators are Edward Lomasney, C. M. Mansean, James Wanless, Charles Mallinson, all of Duluth, and Alexander W. Stow, of Superior, Wis.

A NEW ENGLAND TELEPHONE DEAL.—The New Bedford *Standard* says that within a short time the Southern Massachusetts Telephone Company, operating all the telephone systems of the state south of Norfolk County, is likely to be absorbed by the New England Telephone & Telegraph Company, operating all the Bell systems of New England, except in Rhode Island and Connecticut.

HOUGHTON, MICH.—Mr. Anson B. Miner and Donald McVichie, of Ishpeming, have concluded a careful examination of the copper country for a Marquette County syndicate and have decided to install a telephone system covering Houghton, Ontonagon and Keweenaw County, to compete with the Bell system. The promoters of the new company are owners of the Marquette County telephone system.

INDEPENDENT TELEPHONE FRANCHISE.—The County Commissioners, of Grant County, at Marion, granted a franchise to A. V. Overshimer and Wilson Addington, the owners of the independent plant in Marion. Franchises have also been secured in Madison County and the counties en route to Indianapolis. It is the intention of Messrs. Overshimer and Addington to begin the work of erecting the line at once.

CONNECTICUT.—Promoters of the Boston & New York Telephone Company say that in despite of adverse legislation they intend to go ahead under the new Connecticut general telephone law and build an extensive system in that state. It will require, however, a large amount of money paid in, as well as the approval by the Superior Court of the public necessity of the enterprise, and the project is not regarded as likely to go through.

MASSACHUSETTS TELEPHONE & TELEGRAPH COMPANY.—Subscribers to the Massachusetts Telephone & Telegraph Company now aggregate close to 5000. It is expected that the company will have secured over 10,000 Boston subscribers when the system is placed in operation a year hence. The company will not experiment with any new devices, such as an automatic switchboard, but will give a service through the instrumentality of the telephone girl. Several miles of conduit will be laid before snow flies.

THE CUMBERLAND TEL. & TEL. CO. through James E. Caldwell, president, has purchased the control of the Ohio Valley Telephone Company, of Louisville, capitalized for $550,000. The Cumberland Company has recently increased its capital stock from $3,000,000 to $6,000,000 and has $1,000,000 bonds outstanding. The stock is selling for $125 and the bonds at 111½. Dividends of 5 per cent. are paid on the stock. Earnings for the year ended March 1, 1899, amounted to $331,340 after all charges. The American Bell Telephone Company owns 45 per cent. of the stock of the Cumberland Company.

JERSEY CITY, N. J.—The Hudson Telephone Company, which recently secured from the Street and Water Board of Jersey City permission to extend its lines through that city, has called a special meeting of its stockholders for this week, at which action is to be taken on the proposition to increase the company's capital stock from $300,000 to $1,000,000. The Street and Water Board last week declared its intention of ordering all telegraph, telephone and electric light wires put underground. The Hudson Telephone Company is likely to secure contracts for the laying of telegraph and electric light wires underground.

HARTFORD, CONN.—The Farmington Valley Telephone Company has filed a certificate of incorporation, with a capital stock of $3500. The incorporators are R. L. Andrews, New Britain; C. K. Hunt, Winsted; George Richards & Co., Unionville; J. H. Bidwell, Collinsville; G. H. Samlow, New Britain; John P. Lewis, Unionville; E. C. Ayer, Unionville; Eugenia C. Ayer, Unionville; William Siering, New Britain; C. E. Jones, New Hartford; R. L. Andrews, W. H. Caldwell, New Britain; T. C. Smith, New Britain; Brady Moody, New Britain; Thomas F. Herbert, Hartford, and Adolf Leupold, New Britain.

TELEPHONE FIGHT.—The two telephone companies at Richmond, Ind., are making unusual preparations for a fight, and it is thought that one of them will have to succumb. Not long since a few local capitalists organized the Home Company to build an oppostion exchange. They worked so quietly that almost before the Central Union Telephone Company, or the public generally, knew anything about it a franchise had been obtained and the contract for the construction let, and 700 subscribers easily secured, twice as many as the old company. The exchange is to be ready by July 1. The new plant is equipped with the best independent service and each telephone has long distance connection. Immediately after the new company secured a franchise the old company began to improve and rebuild the local plant. Some changes will be made in the rates and the two companies will, in a short time, be fierce competitors and bidding for the city business.

TELEPHONE WAR.—A fierce telephone rivalry is on in the city of Auburn, Ind., between the National, or Home, and the Bell Telephone Companies. For a number of years the two companies have been operating exchanges in Auburn, enjoying about equal patronage, much to the dislike of the business men and citizens generally. In order to reach all the people it was necessary for business men and citizens to patronize both companies. Realizing this double expense to be a waste of money, the business men set about to buy the Home exchange. The deal was nearly closed when the Bell Company offered service at greatly reduced rates. This was followed by a reduction by the Home Company, and now the rate is $12 per year for residences and $24 per year for business houses. The matter is not yet adjusted, and the cause is being aired in the papers. A $12 business rate is threatened. Many citizens are stockholders in the Home Company, and the feeling generally is to stand by the company that made it possible to obtain better rates.

NEW ENGLAND TELEPHONE.—The new $3,000,000 increase in the stock of the New England Telephone & Telegraph Company will be offered to stockholders pro rata at par. As the company is organized under New York laws, Massachusetts commissioners have no control over the price at which the stock must be sold. The proceeds of the sale of the stock will be used in paying the cost of new subscribers and extending underground plant and the extra territorial lines. The cost of connecting new subscribers in the New England territory averages about $140 each. This includes the proportionate cost of underground and switching plant. Five hundred thousand dollars of the new stock will be set aside for the extra territorial lines, leaving $2,500,000 for subscribers. This will connect about 18,000—a year's growth of the system. The stock will all be taken at par. The American Bell, owning about 51 per cent., will take $1,500,000 of the new stock. The proceeds from the sale of the $2,000,000 bonds by the American Bell Company will be used in part in the purchase of New England stock.

INDEPENDENT TELEPHONY IN FORT WAYNE.—In December, 1895, the Home Telephone & Telegraph Company of Fort Wayne, Ind., was incorporated, with an authorized capital of $100,000, which was increased in 1897 to $250,000. The first board of directors was George W. Beers, Louis Fox, W. J. Vesey, C. S. Bash, Charles McCulloch, S. M. Foster, C. F. Pfeiffer, C. D. Law and John W. Sale. The officers were George W. Beers, president; S. M. Foster, vice-president; Louis Fox, secretary; Charles McCulloch, treasurer. At the time of the incorporation of the Home Company, the Central Union Telephone Exchange had 528 subscribers in Fort Wayne. The solicitors employed by the new company were energetic, and by Jan. 1 had contracted for the use of about 600 instruments. Application was then made to the board of public works for a franchise, which was granted, for the erection, operation and maintenance of a complete telephone system, covering all portions of the city, at annual rates of $36 for business and $25 for residence telephones, respectively. The new exchange was opened on Oct. 1 with 836 subscribers. Notwithstanding the many predictions that no independent telephone company could procure apparatus to successfully operate an exchange of that size, the service was made first class, and has been maintained ever since. The Home company's business steadily increased to a total of 1558 paying subscribers at the end of the second year, Sept. 30, 1898, and has earned and paid dividends during each quarter of its existence, beginning with the first. At the last annual election of the company, held in December, 1898, Mr. Beers and his friends laid down the burden of management which they had successfullly conducted through the trying times of construction and organization, leaving the property in a most prosperous position among the independent exchanges. The new board of directors consists of C. S. Bash, president; C. Hettler, vice-president; W. L. Moellering, secretary; Max B. Fisher, treasurer; L. C. Hunter, H. C. Sites, C. D. Law, John W. Sale and Isadore Lehman, representative business men of the city, under whose management the same high degree of prosperity is assured.

ELECTRIC LIGHT AND POWER.

INDIANAPOLIS, IND.—The Edwards Railroad Electric Light Company has been organized, with a capital stock of $1,500,000. It is licensed in Illinois for $500.

BALTIMORE, MD.—The United Electric Light & Power Company has agreed to furnish electricity for the city street lighting for one year at 35 cents per light per night.

ROCKFORD, ILL.—The Rockford General Electric Company has certified to a change of name to the Rockford Edison Company and to an increase in capital stock from $50,000 to $350,000.

PRINCETON, MINN.—The contract for the construction of the electric light and water works plants at this place has been let to W. I. Gray & Co., of Minneapolis. The cost is not to exceed $17,000.

SEDALIA, MO.—The Sedalia Electric & Heating Company, of Sedalia, has been organized, with a capital stock of $100,000, by J. C. Van Riper, S. H. G. Stewart, A. M. Trader, John Montgomery and others.

EAST ORANGE, N. J.—The Merchants' Electric Light & Power Company, of East Orange, has been organized, with a capital of $125,000, by Walter Ross, W. A. Himebeurgh, C. F. Gosser, E. C. Dyer and C. B. McCoy.

DUBUQUE, IOWA.—The property of the Dubuque Light & Traction Company was sold at auction recently. The property brought $50,000, and was bid in for the General Electric Company, which holds a majority of the bonds.

MT. KISCO LIGHTING COMPANY, of White Plains, N. Y., has been organized, with a capital of $20,000. Directors: David Cromwell, Charles D. Horton, R. B. Goodman, White Plains; H. G. Runkle, Plainfield, N. J.; T. E. Carpenter, Mt. Kisco, N. Y.

ALTON, ILL.—The Alton Railway, Gas & Electric Company has been organized in this city, with a capital stock of $250,000. The purpose of the company is to operate street railways in Madison and St. Clair Counties, and to furnish gas and electricity for light, heat and power purposes.

HAZLETON, PA.—The Hazleton Electric Light & Power Company has been organized here to supply light, heat and power. Its capital stock is $1000, and the incorporators are H. J. Ross and R. M. Hughes, Pittston; A. A. Sterling, T. F. Ryman, Wilkesbarre, and J. B. Reynolds, Kingston.

UTICA, N. Y.—Mr. H. C. Markham has purchased the water power on the Black River at Hurlbutville. Mr. Markham contemplates forming a company to furnish Boonville, Fort Leyden and Lyon Falls with electricity for light and power purposes. By building a dam a head of 25 feet may be obtained.

CAMDEN, N. J.—The Wildwood, Holly Beach & Anglesea Electric Light, Heat & Power Company has filed articles of incorporation to construct and operate electric light plants. The capital stock of the company is $30,000, and the incorporators are Spencer Simpson, of Haddonfield; P. W. Wiltbank and John M. Mays, Philadelphia.

TUNKHANNOCK, PA.—The plant of the Tunkhannock Light, Heat & Power Company was sold on foreclosure proceedings a few days ago, the property being sold to Mr. W. E. Little for $8000. Mr. Little represented the bondholders. The new proprietors propose to pay the claims outstanding against the old company and put the plant in good condition.

SAN FRANCISCO, CAL.—The Independent Electric Light & Power Company is rapidly perfecting arrangements to enter the field in active competition with other concerns engaged in the same line of business. The contract for the construction of an underground system of conduits involving an outlay of $1,500,000 has just been entered into with Gray Brothers. The work will be commenced at once and hurried to completion.

HOBOKEN, N. J.—The North River Heat, Light & Power Company which for several months past has been making vigorous efforts to obtain an electric light franchise in the various municipalities in North Hudson, has, it is reported, given up the fight and sold out the Shanley syndicate which controls the Hudson Electric Light Company. The latter company furnished light to

Hoboken, West Hoboken, Guttenburg, Union Hill and other places, and has a complete monopoly of the business throughout Hoboken and North Hudson. It was later reported that the North River Light, Heat & Power Company had been absorbed by the Hudson County Gas Light Company, of Hoboken. No definite information regarding the transaction can, however, be obtained. President Dod of the gas company denied that his company had made the purchase.

TORONTO, ONT.—It is stated that a syndicate of capitalists of this city has purchased the franchises and property of the St. Hyacinthe Power & Electric Company, of St. Hyacinthe, Quebec. According to the report, extensive improvements will be made, for which considerable machinery and supplies will be required. The Stadacona Electric & Water Company, of Thurso, Quebec, is also to make extensive improvements, for which an appropriation of $18,000 has been made by the town.

NEW YORK, N. Y.—The New York & Queens Gas & Electric Company, organized recently with a capital stock of $1,000,000, has absorbed all the electric and gas companies in the Borough of Queens, excepting the Electric Illuminating Company, of Long Island City. The directors of the new corporation are Charles F. Matthewson, John Frederick Eagle and Edward C. Wilson, all of Manhattan; Henry L. Snyder, of Montclair, N. J., and Edward J. Patterson, of Plainfield. It is the purpose of the new company to manufacture and deliver gas, electric light, heat and power in any part of the city of New York.

HOBOKEN, N. J.—The Hoboken Common Council has entered into an agreement with the North Hudson Electric Company by which the city obtains a reduction in the price of its electric lamps. The action, however, may be contested in the courts. Recently the North River Electric Company offered, if the city authorities would abrogate the contract with the North Hudson Company, yet having three years to run, to light the city for one year free of charge, and at the end of the year to bid for the street lighting at the rate of $80 per year per lamp. The object was to obtain a franchise. The North Hudson Company offered to furnish the lights at $100 a year, the old price having been $138.70 per lamp per year. This offer was favorably considered and accepted by the council. The friends of the North River Company claim that this is not the best that could have been done, and that if their offer had been accepted the city would have saved $27,740 this year alone, based on the old contract, and $20,000 if calculated upon the new one.

THE ELECTRIC RAILWAY.

HARRISBURG, PA.—The Ashland & Centralia Electric Railway Company has been incorporated, with a capital stock of $1000.

THE DAYTON & EATON ELECTRIC RAILWAY is at work securing a franchise to extend its line from Eaton to Richmond.

NEWARK, OHIO.—The Newark & Granville electric railway has been appraised at $248,000 and the receiver has been ordered to sell it.

THE OXFORD & CINCINNATI ELECTRIC RAILWAY is to be extended to Eaton, Ohio, making a fifty-mile line when completed.

BOSTON, MASS.—A charter has been granted to the Clinton & Hudson Street Railway Company. The line will be seven miles in length.

MANKATO, MINN.—The Mankato Street Railway, Lighting & Power Company has been incorporated, with a capital stock of $500,000.

DOVER, DEL.—A certificate of incorporation has been issued to the Beacon Motor Traction Company, of Boston. The company's capital stock is $1,000,000.

POMEROY, OHIO.—Messrs. Camden & Spilman, of Parkersburg, have been granted a franchise to build an electric railway from Middleport to Racine, a distance of 14 miles.

OWENSBORO, KY.—The Owensboro Electric Railway Company has secured the right of way through McLean County, and prospects are good for like success in Davies County.

ANN ARBOR, MICH.—Mr. H. T. Morton, a local capitalist, will ask the city for a franchise to build an electric railway 3½ miles long to connect with the proposed Ypsilanti-Saline railway.

MERIDEN, CONN.—It is stated that the New York, New Haven & Hartford Railway Company will probably sell the Meriden street railway to the Connecticut Lighting & Power Company.

SPRINGFIELD, OHIO.—It is stated that the Springfield Street Railway Company has decided to build an interurban line between this city and Hillsboro, by way of Clifton, Cedarville and Jamestown.

MIDDLETOWN, N. Y.—Judge Gildersleeve, of the Supreme Court, has granted an order dissolving the Middletown & Goshen Traction Company, and appointed as permanent receiver Mr. William Royce.

MORRISTOWN, N. J.—The Morris County Traction Company has been organized, with a capital stock of $250,000. The incorporators are John H. Capstick, Montville; Robert H. Foote, Morristown; George W. Stickle, Rockaway, N. J.

NEWARK, N. J.—The White Line Traction Company has been organized in this city to build and operate a railway. The capital stock is $4,000,000, and the incorporators are Frederick W. Enger, Edward A. Pruden and George Barker, all of Newark.

COLUMBUS, OHIO.—The Springfield, Columbia & Zanesville Electric Railway Company has been organized, with a capital stock of $10,000. The incorporators are J. A. Mehling, A. T. Seymour, W. H. Jones, D. T. Keating, S. W. Hubbard, all of Columbus.

NEW HAVEN, CONN.—The Connecticut Lighting & Power Company has purchased the New Britain electric railway system and lighting plant. The company already owns the South Norwalk Railway Company, and is understood to control the Waterbury Traction Company.

NEW YORK, N. Y.—The New York & Long Island Terminal Railway Company, capital $7,500,000, has been incorporated. The object of the company is to run electric or other railway from Flatbush and Atlantic Avenues under East River to Broadway, south of Fulton Street, Manhattan.

BOSTON, MASS.—A charter has been issued to the Lexington & Boston Street Railway Company. The line commences at Arlington Heights and will run through Lexington and Bedford to Billerica, a distance of 17 miles, with branches in Waltham and Billerica. The capital stock is $170,000.

COLUMBUS, OHIO.—The County Commissioners have been asked to grant a franchise to a company to be known as the Columbus, New Albany & Johnstown Traction Company, of this city, connecting the towns named with Columbus. Mr. J. W. Dusenbury is president and Mr. W. J. Dusenbury secretary.

AKRON, OHIO.—The Akron & Cuyahoga Falls Rapid Transit Street Railroad's strike has been settled by the company granting the wage demands of the men, though declining to recognize the union. This company is owned by Henry A. Everett, of Cleveland, president of the Big Consolidated of Cleveland.

HUNTSVILLE, ALA.—The Huntsville Electric Street Railway Company has been incorporated, with a capital stock of $100,000. The new enterprise is backed by the Dupont syndicate of Johnstown, Pa. The officers are T. C. Dupont, president; T. W. Pratt, vice-president; John H. Waters, treasurer; N. F. Thompson, secretary and general manager.

ALBANY, N. Y.—The Greene County Traction Company and the Coxsackie & Greenville Traction Company have been consolidated. The new corporation is to be known as the Coxsackie & Greenville Traction Company, and its capital stock is $200,000. The directors are T. E. Smith, J. D. Farrington, Dr. James D. Perry, G. L. Allin, William S. Smith, G. C. Spencer, of New York; William S. Vanderbilt, of Greenville; Newton A. Calkins, of Coxsackie, and Lucius Smith, of Ridgewood, N. J.

KANSAS CITY, MO.—The East Side Electric Railway Company has increased its capital stock from $2000 to $200,000. Contracts have been made with the Lorain Steel Company, Lorain, Ohio, for over 600 tons of 82-pound rails, the St. Louis Car Company for eight 28-foot cars, the Westinghouse Electric & Manufacturing Company for the electrical equipment, and the St. Louis Iron & Machine Company for a 230-hp Corliss engine. It is expected that a portion of the line will be in operation by Aug. 1.

PHOENIX, ARIZ.—The Pacific Electric Railway Company has filed articles of incorporation and is capitalized at $200,000. The incorporators are I. W. Hellman, H. E. Huntington, Antoine Borel, Charles de Guigne, H. W. Hellman, J. Kuhrts, Frank P. Flint, T. M. Nickell and Charles Seyler, all of California, and E. Randolph and Charles Drage, of Arizona. The object of the company is to operate an electric railway from Phoenix to Tempe and to own and operate a mile of street car line in Los Angeles. The principal place of business will be Los Angeles, Cal.

ATLANTA, GA.—The Atlanta Consolidated Street Railway Company has made application to the Superior Court for permission to change the name of the corporation to the Atlanta Railway & Power Company. The new company will have complete control of the Consolidated Company's lines and of those formerly belonging to the Atlanta Railway Company. The financial department of the two lines is now under one control and has been for several weeks. After the reorganization is complete one of the earliest undertakings will be the construction of a new power plant.

LEXINGTON, KY.—The deal for the consolidation of the street railways and electric light properties in this city has been closed and officers and directors of the new corporation have been elected as follows: Mr. R. Lancaster Williams, of Richmond, president, and Messrs. J. William Middendorf and S. Davies Warfield, of Baltimore, were elected members of the board. The new company is capitalized at $800,000, and will issue $830,000 in 5 per cent. gold bonds. It will operate about 17 miles of track and furnish electric light and power for manufacturing purposes. The consolidation was arranged by Messrs. Middendorf, Oliver & Co., of Baltimore. Mr. E. C. Hathaway, of Charlotte, N. C., will have charge of the properties.

ATLANTA, GA.—A charter has been granted to the incorporators of the Dahlonega Railway Company, with a capital of $300,000. Among the incorporators are J. W. Adams, of Chattanooga; J. W. Smith, of Michigan; George H. Beyman and Frank G. Thompson, of Ohio, and W. P. Price and W. A. Charters. The road will be 30 miles long when completed and will run from Dahlonega, Ga., to the Southern Railway, with which it will connect just within the Georgia boundary. The proposed trolley line from Gainesville to the Southern Railway, going north 100 miles, will be built, so G. W. Evans, of New York, says. The electric power for the road will be generated by water power, and the road will be constructed at once.

CHICAGO, ILL.—It is reported that an arrangement is being planned by the officers of the Interlake Electric Railway Company and the officials of the Milwaukee & St. Paul, Northwestern and Wisconsin Central Railways, by which the cars of the electric line will be run over the tracks of the steam roads to and from the Fox Lake district to points wherever the travel may justify. The plan is for the electric company to build cars of standard steam railway gauge and have them attached to the regular passenger trains of these roads in Chicago, Milwaukee, Madison and other places and run them through to the lakes. The Interlake Company's line will run from a point near the lake bluff up to the shores of Fox and adjacent lakes. None of the railroads named runs within several miles of Fox Lake.

TERRE HAUTE, IND.—The Russell Harrison Street railway and electric lighting property was sold on June 21 at receiver's sale for a total of $560,000, which, it is thought, will be enough to pay the original $400,000 in bonds at par without interest, and the second mortgage bondholders at 10 or 15 cents on the dollar, in addition to caring for $25,000 in receiver's certificates and $40,000 in street improvement bonds. The purchasers are representatives of Lee, Higginson & Co., of Boston, who in turn represent Boston capitalists who have been investing largely in street railway and electric light properties on the advice of Stone and Webster, experts in the business. The new owners have a franchise for a trolley line from here to Brazil, 16 miles, and also have bought on the side the local competing electric light plant.

EDUCATIONAL.

MICHIGAN COLLEGE OF MINES.—At a recent meeting of the Board of Control of the Michigan College of Mines, Professor Fred W. McNair was unanimously elected president of the institution. Professor McNair has been for some years in charge of the department of mathematics and physics, and so closely identified with the work and growth of the college that its history, aims and methods are entirely familiar to him.

THE POLYTECHNIC INSTITUTE OF BROOKLYN.—The catalogue of the Polytechnic Institute of Brooklyn for the season 1898-99 gives much information regarding the organization and the plan of instruction carried on by this well known institution. A new course in mechanical engineering has been added to the scope of the Institute, and it will be inaugurated with the next fall term. The work of the new course will be like that pursued in the same course of study in similar technical institutions.

PERSONAL.

MR. F. L. FROST, electrical engineer for State hospitals, recently passed the New York State civil service examination for electrical expert. He is at the top of the list with an everage of 97.72.

MR. JESSE R. SPAULDING, head of a big lumber firm and formerly collector of the port of Chicago, has accepted the position of president of the newly organized Chicago Union Traction Company, which controls the local street railways.

GEN. LEONARD WOOD, military governor of Santiago province, Cuba, and formerly Colonel of the Rough Riders, has been offered the presidency of the new consolidation, the Washington (D. C.) Traction & Electric Company.

MR. SAMUEL INSULL, president of the Chicago Edison & Illinois Electric Vehicle Company, while crossing Wabash avenue, Chicago, last Saturday, was knocked down by a runaway cab horse, and was badly cut about the face and head. A telegram received June 27 by us from the Chicago Edison Company says: "Injuries not serious; expect him at the office in a day or two." Mr. Insull's host of friends congratulate him on his narrow escape, and urge him to redouble his efforts to eliminate the horse.

MR. V. E. RAGGIO, who for many years has been connected with the Commercial Electrical Supply Company, of St. Louis, Mo., has associated himself with the Western Electrical Supply Company of the same city, and will travel the Southwest in the interest of that company. Mr. Raggio has been very successful throughout that section of the country, and will no doubt continue to receive liberal patronage, as he will certainly be fully supported by the enterprising company with which he has connected himself.

MR. A. L. JOHNSON.—A. L. Johnson, lately the President of the Nassau Railway of Brooklyn, N. Y., has been investigating electrical traction prospects in England and returned home on the Majestic. He says: "London is the greatest field in the world for the future development of electric surface roads. I have only made a preliminary examination, but shall return in a few weeks, when I expect to thoroughly take up the project. There is no doubt London in a few years will afford an immense market for American electric appliances and rails."

OBITUARY.

JOHN GODFREY MOORE, head of the banking and brokerage firm of Moore & Schley, died in New York City on June 23, in his fifty-second year. He came to New York from Maine in 1865 and engaged in the lumber and contracting business. In 1880 he and J. O. Evans organized with others the American Union Telegraph Company, which was absorbed by the Western Union. They next formed the Mutual Union, which, in turn, was leased by the Western Union, Mr. Moore becoming a director of the latter. The firm of Moore & Schley was formed in 1885. At the time of his death Mr. Moore was a director in the American District Telegraph Company.

Trade and Industrial Notes.

MR. WILLIAM TAYLOR, Mail and Express Building, New York City, is agent for Messrs. Johnson & Morton, Utica, N. Y., for Greater New York and New Jersey.

THE CENTRAL ELECTRIC COMPANY, Chicago, is much pleased with its growing business in the Bullock apparatus, Columbia incandescent lamps and Zeco arc lamps.

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, of Scranton, Pa., have brought suit against two institutions of like character for infringement of the copyrights covering its instruction and question papers.

THE WESTERN ELECTRIC COMPANY has furnished the Calumet Printing Company, Chicago, a 40-hp motor to operate its printing presses. The construction department of the Western Electric Company installed the plant.

THE AMERICAN ELECTRIC SPECIALTY COMPANY, 123 Liberty Street, New York, has secured the agency for Charles Wirt & Co., Philadelphia, Pa., for the sale of Wirt rheostats, theatre dimmers, resistance plates and dynamo brushes.

THE RARITAN COPPER COMPANY will build a new furnace building at Perth Amboy, N. J., and has placed the contract with the Berlin Iron Bridge Company, of East Berlin, Conn. The building will be constructed entirely of steel, with traveling cranes, runways, etc.

THE TEHAMA ELECTRIC COMPANY has been organized in San Francisco to do a general electrical business. The capital stock is placed at $50,000, and the names of the incorporators are J. Cross, G. F. Hanson, M. F. Michael, C. W. Willard and A. H. Winn, all of San Francisco.

THE DAYTON FAN & MOTOR COMPANY, Dayton, Ohio, reports that it is swamped with business, and that it has been compelled to refuse orders for at least 2000 motors. Notwithstanding the fact that it has doubled its producing capacity, the company is again contemplating doubling the size of its plant.

THE NEW ERA ELECTRIC PROTECTION COMPANY has been organized in Portland, Me., with a capital stock of $100,000. The incorporators are James H. Clark and George H. Clark, both of Boston, Mass.; George W. Mason, of East Cambridge; George D. Kemp, of Dorchester, and Philip J. Larrabee, of Portland.

THE HARVARD ELECTRIC COMPANY, 224-226 South Clinton Street, Chicago, is pleased with the rapidly increasing orders for the Standard single pole and double pole combined fusible cut-outs and carbon lightning arresters. These lightning arresters are to be found in nearly every independent telephone exchange in the country and are said to be giving entire satisfaction.

THE WATERTOWN ENGINE COMPANY, Watertown, N. Y., reports receiving in one day orders for 12 engines, as follows: 1 horizontal cross-compound for the St. Albans Electric Light Company; 4 belted engines for a Hudson River line of steamers; 2 direct-connected and 2 vertical cross-compound for the Pennsylvania Railway lines west of Pittsburg; 1 tandem compound horizontal for Ruppert's Brewery, and 2 vertical-belted for the United States Navy Yard.

THE WESTERN ELECTRIC COMPANY, Chicago and New York, has issued a bulletin giving illustrations and brief descriptions of the Facil pen register and other accessories of the Ellicott system of police and fire alarm. Among the illustrations are shown a 5-hp motor generator equipment for police and fire alarm signal work; a gang of motor generators used in the Chicago City Hall; diagram of circuits for police and fire alarm circuits, and various telegraph instruments.

MR. H. C. CUSHING, JR., author of the handbook, "Standard Wiring for Electric Light and Power," as adopted by the Fire Underwriters of the United States, reports that he is meeting with a larger demand than ever for this useful little book. The fact that it has been adopted and required by the electrical engineering department of Cornell University, Stanford University and other technical universities and schools, is the best evidence that its accuracy and practical value is appreciated by engineers and construction men generally.

MESSRS. CHARLES H. BESLY & CO., 10 North Canal Street, Chicago, Ill., call attention to their Mannocitin. It is claimed to be an absolute rust preventive for machinery, engines, tools and all metals. Mannocitin is composed of greases and volatile oils and is said to be absolutely neutral and to remain so. It contains no acids and withstands salt air, salt water, rain, steam, gases and fumes of acids and ammonia. The firm's new 1899 catalogue is now ready for distribution and a copy will be mailed to any address on application.

THE JOHN KAMMER INCANDESCENT LAMP COMPANY, 176 Indiana Street, Chicago, has been compelled to increase its facilities in order to anticipate the growing demand for its "New Rival" lamp. The company expects that this lamp will be adopted by several railway companies for use in lighting their principal stations and also on their limited trains. A large order was received this week from a house located in a distant state. The Kammer Company is greatly encouraged at the outlook for the demand for lamps during the ensuing season.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is reaping the reward for enterprise in the large orders it is booking for "O. K Slow Burning Weatherproof" and "O. K. Slowing Burning" or "Underwriters" wires. The promptness with which the company placed these wires upon the market to meet the new requirements of the National Board of Fire Underwriters has been noted by the users of wire all over the country. These wires have been made to strictly comply with the rules of the National Fire Board relating to slow burning wires for inside wiring.

MESSRS. EAGER & LOUNSBERY have succeeded Frank R. Eager in the electrical construction, equipment and supply business in Syracuse, N. Y., and have removed to 207 Walnut Street. The firm desires to secure catalogues on all electrical goods. It represents the Jandus Electric Company exclusively in central and western New York, and reports that it has met with excellent success in its business so far, having secured a number of good contracts for construction work. Some of its sales of Jandus lamps have been to the New York Central Railway, the National Railway Spring Company and the Fitzgibbons Barter Company, of Oswego; D. M. Osborne & Co., Auburn, N. Y.; the Syracuse Chilled Plow Company, and the Malleable Iron Works, Syracuse. The firm is composed of Mr. Frank R. Eager and Frank C. Lounsbery.

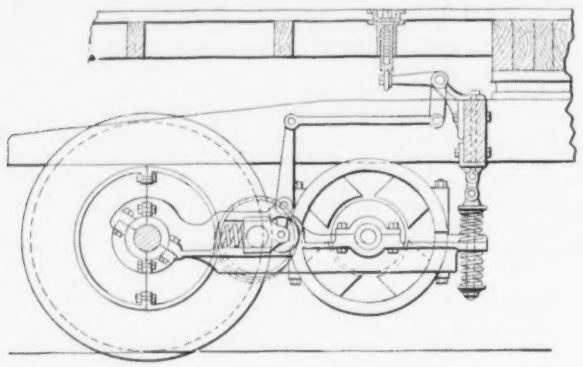
EXPORT ORDERS FOR ELECTRICAL APPARATUS.—Messrs. Westinghouse, Church, Kerr & Co., New York, have recently erected a complete electric lighting plant at the Senado Plantation, owned by Senor Bernabe Sanchez Adan, at Minas, Puerto Principe, Cuba. The order came through Messrs. Mosle Bros., New York. The installation consists of a 75-hp Westinghouse standard engine, direct connected to a 50-kw Westinghouse "engine type" generator. Lamps, wiring, and all material were shipped. The plant comprises about 500 incandescent and 25 arc lights. This is among the first of the direct-connected electric lighting plants erected in the interior of Cuba. An export order is being executed by the Westinghouse Electric & Manufacturing Company, for Dutch Guiana, comprising a 7½-kw Westinghouse generator, 120 volts, compound wound. The order also includes a switchboard, two direct-current fan motors and four Wurts non-arcing lightning arresters. Another export order is for Venezuela, from the New York and Bermudas Company, of New York. The contract calls for a 6-kw, 220-volt, direct-current, belted Westinghouse generator; a switchboard, two Wurts non-arcing lightning arresters, eight enclosed arc lamps. This outfit is to supply light for working asphalt beds at night.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JUNE 20, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

627,105. APPARATUS FOR LIGHTING CAR LAMPS; H. C. Farquharson, New York, N. Y. App. filed Aug. 13, 1898. This is a means for electrically lighting the well known Pintsch gas lamp, and consists in running the electric conductors downward through the chimney of the lamp and encasing them in earthenware tubes to protect them from the heat.



627,246.—Generating Electricity for Cars, etc.

627,106. APPARATUS FOR ELECTRICALLY LIGHTING LAMPS; H. C. Farquharson, New York, N. Y. App. filed Dec. 8, 1898. Relates to the preceding and consists of a sparking point holder arranged above the chimney, and supported upon its upper edge by three wire legs.

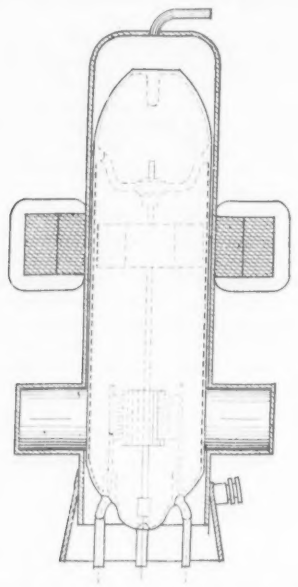
627,133. ELECTRIC VEHICLE; William M. McDougall, East Orange, N. J. App. filed Aug. 4, 1898. (See Current News and Notes.)

627,134. SECONDARY BATTERY; William M. McDougall, East Orange, N. J. App. filed Aug. 4, 1898. (See Current News and Notes.)

627,144. ELECTRIC TRANSFORMER; G. A. Scheeffer, Peoria, Ill. App. filed Jan. 11, 1899. (See Current News and Notes.)

627,155. ELECTROSTATIC MEASURING INSTRUMENT; E. Thomson, Swampscott, Mass. App. filed Apr. 18, 1898. (See Current News and Notes.)

627,192. BURGLAR ALARM; C. Johnson, Chicago, Ill. App. filed Feb. 19, 1898. A portable circuit closer for burglar alarms, consisting of two small blocks pivoted together and having a spring between them, tending to throw their ends together when allowed to do so. The two blocks may be inserted into a keyhole which will compress the spring, and hold the contacts apart until a key forces them out of the hole, whereupon the connection is made and alarm given.



627,346.—Cooling Jacket for Vacuum Circuit Interrupters.

627,226. GAS LIGHTING APPARATUS; H. C. Farquharson and D. F. Root, New York, N. Y. App. filed June 14, 1897. The conductors are encased in tubes which insulate and protect them from the heat of the burner.

627,242. ELECTRIC RELAY; H. B. Taylor, Newark, N. J. App. filed Aug. 27, 1898. The armature of the relay is provided with a carbon and a metal contact co-operating with corresponding contacts of carbon and metal; one carbon contact has a concave and the other a convex engaging face, and one of them is yieldingly mounted. The object is to prevent injurious sparking.

627,243. RAILWAY SIGNAL; H. B. Taylor, Newark, N. J. App. filed Oct. 15, 1898. The invention involves the use of an electric motor for moving the semaphore, the motor being connected to the semaphore by means of worm-gearing; also a novel system of electric circuits for controlling the operation of the motor.

627,245. RAILWAY SIGNAL; J. Weyland, Newark, N. J. App. filed July 13, 1898. To prevent the uncertainties of operation due to sparking of the signal operating contacts, the circuit breaker is provided with elastically mounted multiple contacts of carbon and metal, and adjusting devices for making the final rupture occur between the carbon surfaces.

627,246. GENERATING ELECTRICITY FOR CARS; J. Weyland, Newark, N. J. App. filed July 26, 1898. A dynamo is mounted upon the truck of the car. Means are provided whereby the generator may be thrown into and out of gear with the axle, and also whereby the working positions of the various parts will not change when the car moves around a curve in the track.

627,295. ELECTRIC HAIR BRUSH; A. H. Burchard, Colorado Springs, Colo. App. filed Dec. 31, 1898. A small battery is housed in the back of the brush. The bristles of the brush, which are metal, are one-half connected to one terminal and the other half to the other terminal, thus making the circuit through the scalp.

627,322. THERMOSTAT INSTRUMENT; C. Burgher, Winthrop, Mass. App. filed June 7, 1898. A weight is held in place by a fusible device, the destruction of which allows the weight to push into contact two overlapping contact arms.

627,326. ELECTRIC LIGHTING SYSTEM FOR CARS; J. L. Creveling, New York, N. Y. App. filed April 10, 1899. The system comprises electric lamps, a storage battery and a generator driven by power derived from the motion of the car, and a switch adapted to reverse the connections between the generator and the battery upon reversal of direction of motion of the car. This switch is operated by frictional contact with a movable member, the direction of motion of which reverses with that of the car.

627,366.—Insulator for Fastening Electric Wires.

627,345. GENERATING ELECTRIC WAVES OR VIBRATIONS; D. McF. Moore, Newark, N. J. App. filed Nov. 16, 1896. For generating waves suitable for producing luminous effects, it is proposed to interrupt a circuit of self-induction carrying a varying current and timing the interruption to take place at or about the maximum of each wave of the varying current.

627,346. COOLING JACKET FOR VACUUM CIRCUIT INTERRUPTERS; D. McF. Moore, Newark, N. J. App. filed Sept. 7, 1898. The invention consists in artificially cooling the vacuous chamber containing terminals between which interruptions of a circuit of induction take place, the object being to increase the luminous effects.

627,366. INSULATOR FOR FASTENING ELECTRIC WIRES; J. Treleaven, Vancouver, Canada. App. filed Jan. 4, 1899. The grooves in the insulator are so shaped that the wire is secured therein by lapping over itself, the wires being dispensed with.

627,376. CONTROLLER; T. Von Zweighberg, Cleveland, Ohio. App. filed Feb. 27, 1899. The brake applying handle is normally independent of the governing and reversing switches, but is adapted to move both of them when occasion requires.

627,408. PACKING CASE FOR ELECTRIC CELLS; M. E. Fuld, Baltimore, Md. App. filed March 25, 1899. The case is of pasteboard and the cover is provided with two openings which, when the cover is properly adjusted upon the case, register with the two binding posts projecting from the head of the cell.

627,417. ELECTRIC MOTOR; A. Hinman, Forrest City, Mo. App. filed Jan. 4, 1899. The improvements relate to the shape of the pole-piece and to the construction of the armature core. The face of the pole-piece is curved at a greater radius than the radius of the armature, while the core is made up of plates of gradually lessening width from the inner to the outer edge of the core.

. . . PUBLICATIONS OF . . .

Electrical World and Engineer.

American Street Railway Investments.
Financial data of over 900 American city, suburban and interurban electric railways, statistics of operation, details of plant and of equipment and names of officers. Published annually..... $5.00

Electrical World and Electrical Engineer.
An Illustarted Weekly Review of Current Progress in Electricity and its Practical Applications. Annual Subscription..... 3.00

General Index to the Electrical World.
From January 1st, 1883, to January 1st, 1897. 372 pages..... 8.00

Alternating Currents.
An Analytical and Graphical Treatment for Students and Engineers. By Frederick Bedell, Ph. D., and Albert C. Crehore, Ph. D. Third edition. 325 pages, 112 illustrations 2.50

Bell's Electric Power Transmission: a Practical Treatise for Practical Men.
The best treatise yet written on the practical and commercial side of electrical-power transmission. Second edition. 500 pages, 231 illustrations 2.50

Bell's Power Distribution for Electric Railways.
Deals with the laying out and calculation of electric railway circuits. Sub-station distribution is also considered. 268 pages, 139 illustrations. 2.50

Alternating Currents of Electricity.
Their Generation, Measurement, Distribution and Application. Authorized American edition. By Gisbert Kapp. 166 pages, 37 illustrations and two plates 1.00

Central Station Bookkeeping.
With Suggested Forms. By H. A. Foster. 139 pages, 123 forms and diagrams 2.50

Dobbs, A. F.
Practical Features of Telephone Work. Illustrated. 12mo, cloth. New York, 1898 ..... 1.00

Dictionary of Electrical Words, Terms and Phrases.
By Edwin J. Houston, Ph. D. Fourth edition. Greatly enlarged.
900 double column octavo pages, 582 illustrations..... 7.00
Pocket edition, 945 pages, cloth 2.50
Pocket edition, 945 pages, leather 3.00

Dynamo and Motor Building for Amateurs.
With Working Drawings. By Lieutenant C. D. Parkhurst. 163 pages, 73 illustrations 1.00

Emmet, William L. R.
Alternating Current Wiring and Distribution. Contains a very clear account of the principles of alternating currents from the practical point of view, and of their distribution and application to lighting and power. Polyphase currents, the load factor, the effects of capacity and inductance, and the various losses in distribution, are simply explained, no mathematics beyond arithmetic being used. 76 pages, 29 illustrations. 16mo, cloth. New York, 1898..... 1.00

Electricity and Magnetism.
Being a Series of Advanced Primers. By Edwin J. Houston, Ph. D. 306 pages, 116 illustrations 1.00

Electricity at the Paris Exposition of 1889.
By Carl Hering. 250 pages, 62 illustrations 2.00

Electrical Measurements and Other Advanced Primers of Electricity.
By Edwin J. Houston, Ph. D. 429 pages, 169 illustrations..... 1.00

Electric Lighting Specifications.
For the use of Engineers and Architects. Third edition, entirely rewritten. By E. A. Merrill. 213 pages 1.50

Electricity One Hundred Years Ago and To-day.
By Edwin J. Houston, Ph. D. 199 pages, illustrated..... 1.00

Electric Railway Motors.
By Nelson W. Perry. 238 pages, 60 illustrations..... 1.00

Electro-Dynamic Machinery.
By E. J. Houston, Ph. D., and A. E. Kennelly, D. Sc. A text-book on continuous-current dynamo-electric machinery for electric-engineering students of all grades. 331 pages, 232 illustrations..... 2.50

Experiments with Alternating Currents of High Potential and High Frequency.
By Nikola Tesla. 146 pages, 35 illustrations..... 1.00

Electrical Engineering Leaflets, Containing the Underlying Principles of Electricity and Magnetism.
By Prof. E. J. Houston and A. E. Kennelly.
ELEMENTARY GRADE—suited to the study of Electrical Artisans, Wiremen and to Elementary Students. 280 pages, 149 illustrations. 8vo, cloth 1.50
INTERMEDIATE GRADE—suited to Students in High Schools or Colleges, and those beginning the study of Electrical Engineering. 280 pages, 110 illustrations. 8vo, cloth 1.50
ADVANCED GRADE—suited to Students taking Technical Courses in Electrical Engineering. 280 pages, 121 illustrations. 8vo, cloth. New York, 1895 ..... 1.50

ELECTRO-TECHNICAL SERIES.

BY E. J. HOUSTON AND A. E. KENNELLY.

Alternating Electric Currents. 225 pages, 77 illustrations..... $1.00
Electric Arc Lighting. 383 pages, 155 illustrations..... 1.00
Electric Heating. 290 pages, 86 illustrations 1.00
Electric Incandescent Lighting. 449 pages, 146 illustrations..... 1.00
Electric Street Railways. 367 pages, 158 illustrations..... 1.00
Electric Telegraphy. 448 pages, 163 illustrations..... 1.00
Electro-Therapeutics. Second Edition. 452 pages, 147 illustrations.... 1.00
Magnetism. 294 pages, 94 illustrations..... 1.00
The Electric Motor. 377 pages, 122 illustrations..... 1.00
The Electric Telephone. 412 pages, 143 illustrations..... 1.00

Gerard's Electricity.
With chapters by Dr. Louis Duncan, C. P. Steinmetz, A. E. Kennelly and Dr. Cary T. Hutchinson. Translated under the direction of Dr. Louis Duncan. 392 pages, 112 illustrations 2.50

Higgins' Street Railway Investments.
Contains full statistical information about 145 American properties before and after change to cable and electric traction. 102 pages 2.00

Hanchett's Electric Railway Motors.
The various commercial types of electric railway motors are described in full detail, including mounting and control..... 2.00

Miller's American Telephone Practice.
A comprehensive treatise, including descriptions of apparatus, line construction, exchange operation, etc..... 2.00

Lectures on the Electro-Magnet.
Authorized American Edition. By Prof. Silvanus P. Thompson. 287 pages, 75 illustrations 1.00

Original Papers on Dynamo Machinery and Allied Subjects.
Authorized American Edition. By John Hopkinson, F. R. S. 249 pages, 98 illustrations 1.00

Practical Calculation of Dynamo Electric Machines.
A Manual for Electrical and Mechanical Engineers, and a Text-book for Students of Electro-technics. By A. E. Wiener. 683 pages, 375 illustrations 2.50

Pratt & Alden's Street Railway Roadbed.
A treatise on the construction of the roadbed, giving data as to rails, methods of track fastening and making joints, guard rails, curves, etc. 135 pages, 157 illustrations 2.00

Recent Progress in Electric Railways.
Being a summary of Current Advance in Electric Railway Construction, Operation, Systems, Machinery, Appliances, etc. Compiled by Carl Hering. 386 pages, 110 illustrations 1.00

Reference Book of Tables and Formula for Electric Street Railway Engineers.
By E. A. Merrill. Second Edition. Flexible Morocco. 128 pages. Interleaved with blank pages 1.00

Shop and Road Testing of Dynamos and Motors.
By E. C. Parham and J. C. Shedd. 520 pages, 163 illustrations..... 2.00

Standard Tables for Electric Wiremen.
By Chas. M. Davis. With Instructions for Wiremen and Linemen, Rules for Safe Wiring and Useful Formulæ and Data. Fourth Edition. Revised by W. D. Weaver. Flexible Morocco. 128 pages, 14 diagrams. 1.00

The Electric Motor and Its Applications.
By T. C. Martin and Jos. Wetzler. With an appendix on the Development of the Electric Motor since 1888, by Dr. Louis Bell. Fourth Edition. 315 pages, 353 illustrations 3.00

The Electrical Transmission of Intelligence and Other Advanced Primers of Electricity.
By Edwin J. Houston, Ph. D. 330 pages, 88 illustrations..... 1.00

The Elements of Static Electricity.
With Full Descriptions of the Holtz and Topler Machines. By Philip Atkinson, Ph. D. Second Edition. 228 pages, 64 illustrations..... 1.50

The Quadruplex.
By Wm. Maver, Jr., and Minor M. Davis. With Chapters on Dynamo-Electric Machines in Relation to the Quadruplex, Telegraph Repeaters, the Wheatstone Automatic Telegraph, etc. 128 pages, 63 illustrations.. 1.50

The Telegraph in America.
By Jas. D. Reid. 804 royal octavo pages, handsomely illustrated. Russia 7.00

The Theory and Calculation of Alternating Current Phenomena.
By Charles Proteus Steinmetz. Second Edition. 439 pages, 184 illustrations 2.50

Universal Wiring Computer.
For Determining the Sizes of Wires for Incandescent Electric Lamp Leads, and for Distribution in General without Calculation, with Some Notes on Wiring and a Set of Auxiliary Tables. By Carl Hering. Third Thousand. 44 pages, 4 charts 1.00

Wheeler's Chart of Wire Gauges. 1.00

Copies of any of the above books or of any other electrical book published will be sent by mail, POSTAGE PREPAID, to any address in the world on receipt of price.

ELECTRICAL WORLD AND ENGINEER, 120 Liberty St., New York.

ALPHABETICAL INDEX TO ADVERTISERS.

Aaron Electric Co....44
Adams-Bagnall Electric Co....39
Advance Specialty Co....27
Akron Electrical Mfg. Co....55
Allen-Hussey Co. 49
American Battery Co....39
American Bell Telephone Co....49
American Electric Specialty Co....
American Electric Telephone Co....51
American Electrical Heater Co....
American Electrical Works....39
American Electric Vehicle Co....39
American Fire Engine Co....66
American Gas Furnace Co....65
American Hard Rubber Co....
American Impulse Wheel Co....23
American Min. & Dec. Lamp Co....
American Vitrified Conduit Co....2
Anderson Mfg. Co., A. & J. M....9
Armitage-Herschell Co. 15
Ashcroft Mfg. Co....
Audit Co., The ....
Aultman Co., The 65
Austin & Co., M. B....14

Bacon Air Lift Co....59
Baker & Co....3
Ball Engine Co....69
Barnes Co., The Wallace....67
Barnes Co., W. F. & John....
Barnett & Co., G. & H....72
Becker Bros. 43
Becker Name Plate Co....7
Belknap Motor Co....
Berlin Iron Bridge Co....
Bernard Co., The E. G....57
Besly & Co., Charles H....72
Bibber-White Co. 11
Biddle, James G. 4
Bickford Drill & Tool Co....69
Bliss Co., E. W....70
Bogart Co., A. L....3
Bogue, Charles J....25
Bossert Electric Const. Co....15
Bowsher Co., N. P....70
Brady, T. H....47
Bristol Company 1
Bryan & Humphrey....45
Bryant Electric Co., The....18
Buckey Electric Co....
Bullock Electric Mfg. Co....60
Bullock Mfg. Co., M. C....65
Bunnell & Co., J. H....15
Burns, John 27
Burrows Mfg. Co....65
Burt Mfg. Co....1

C & C Electric Co....57
Cameron, H. P....44
Camp Co., The H. B....3
Carlisle & Finch Co., The....27
Carpenter Die & Tap Co., J. M....72
Cary Spring Works....1
Case Mfg. Co....67
Central Electric Co....52
Central Mfg. Co....2
Central Telephone & Electric Co....47
Chicago Belting Co....72
Chicago Edison Co....42
Chicago Fuse Wire & Mfg. Co....
Chicago General Fixture Co....4
Chicago Insulated Wire Co....45
Chicago Rheostat Co....39
Cincinnati Milling Machine Co....69
Cleveland Armature Works....
Cohn & Bock....47
Colt & Co., J. B....
Columbia Incandescent Lamp Co....12
Colwell Lead Co....3
Commercial Electric Co....55
Conn. Telephone & Electric Co....47
Conover Mfg. Co....68
Consolidated Safety Valve Co....68
Cooper & Co., The C. & G....72
Crane Co. 67
Creaghead Engineering Co....22
Crocker-Wheeler Co. 58
Crosby Steam Gage & Valve Co....21
Croselmire, C. F....2

Cutler-Hammer Mfg. Co....25
Cutter Co., George....7
Cutter Co., The....24
Cutter Electrical & Mfg. Co....1

Dake Engine Co. 69
Dayton Globe Iron Works Co....28
Dearborn Drug & Chemical Works....26
Delaware Hard Fibre Co....72
Diamond Meter Co....
Diehl Mfg. Co....17
Directory of Engineers....45
Dixon Crucible Co., Jos....4
Dyer, Edmonds & Dyer....39

Eames Co., G. T....70
Eastern Electric Cable Co....
Eccleston Lumber Co....2
Eddy Electric Mfg. Co....59
Edison Dec. & Min. Lamp Dept....30
Edison Mfg. Co....11
Edwards & Co....10
Elbridge Electrical Mfg. Co....
Electrical Engineer Inst. of Cor. Inst....11
Electric Appliance Co....30
Electric Motor & Equipment Co....25
Electric Storage Battery Co....3
Electrose Mfg. Co., The....54
Elliott Electric Co., W. H....42
Elwell-Parker Electric Co., The....55
Emerson Electric Mfg. Co....21
Empire China Works....39
Empire Electrical Instrument Co....27
Engineers, Directory of....45
Enright, John 72
Ericsson Telephone Co....47
Eyanson & Armpriester....7

Fagan, J. C....10
Falk Company, The....8
Farr Telephone Const. & Supply Co....50
Felten & Guilleaume....
Field & Everett....
Forest City Electric Works....2
Franklin Electric Supply House....
Freed, Henry F....
Frick Co. 69
Frink, I. P....21
Ft. Wayne Electric Works....13
Fuller Co., The....16
Fuller, John E....17

Garlock Packing Co....
Garton-Daniels Electric Co....22
Garvin Machine Co....22
Gates & Randolph....45 and 56
General Electric Co....6
General Equipment Co....10
General Incandescent Arc Light Co....44
Goldmark & Wallace....39
Goldsmith Bros. 28
Gold Street Car Heating Co....30
Gordon Battery Co....17
Goubert Mfg. Co., The....67
Green Fuel Economizer Co....67
Gregory Co., Charles E....40 and 41

Hadaway Electric Heating & Eng'g Co..25
Hammacher, Schlemmer & Co....
Hardtmuth & Co....21
Hardy Lamp Company....22
Harrington, Son & Co., Ed....
Harrisburg Foundry & Machine Wks....66
Harris, F. R....
Hart & Hegeman Mfg. Co., The....5
Hartford Steam Boiler Inspection & Insurance Co. ....
Hart Mfg. Co....7
Harvard Electric Co....49
Harvey Co., The G. F....2
Hayden & Derby Mfg. Co., The....
Hays Construction Co. 59
Heald & Son, L. S....70
Heine Safety Boiler Co....
Herrick, A. B....45
Hobart Electric Mfg. Co....72
Hochhausen & Hall....43
Hoffman, George W. 42
Holmes Fibre-Graphite Mfg. Co....55
Holtzer-Cabot Electric Co....53
Homer & Co., F. L....43

Horry, William Smith....
Houston & Kennelly....45
Huebel & Manger....25
Huebsch & Co., D. A....
Hunt Co., C. W....68
Hunter Fan and Motor Co....15
Hunter Machine Co., James....67

Ide & Sons, A. L....63
Illinois Insulated Wire Co....46
India Rubber & G. P. Ins. Co....72
Insulating Saddle Staple Co....47
International Electric Co....3
Iron Clad Resistance Co....27

Jandus Electric Co....
Jeffrey Mfg. Co....68
Jenkins Bros. 1
Jenney Electric Mfg. Co....55
Jessop & Sons, William....
Jewell, E. W....39
Johns Hopkins University....
Johns Mfg. Co., W. H....3
Johnson & Morton....57
Jonnston, Thomas J....45
Jones & Sons, J....22
Jonson & Co....65

Kammer Co., John....30
Kartavert Mfg. Co....26
Kelly & Krotz....62
Keuffel & Esser Co....72
Keystone Electrical Instrument Co....21
Kinsman, Frank E....45
Kittredge, Smith & Co....22
Klein & Son, Mathias....11
Klipstein & Co....30
Knapp Electric & Novelty Co....26
Knowles, C. S....30
Kokomo Telephone & Elec. Mfg. Co....48
Kosmic Oil Filter Co....21
Kuhlman Electric Co....30

Laclede Battery Co....53
Lafayette College 11
LaKon Co., The 25
Large & Co., S. D....22
La Roche & Co., F. A....1
Lea Mfg. Co....10
Leather Preserver Mfg. Corp....
Leclanche Battery Co....3
Leffel & Co., James....29 and 69
Leschen-Macomber-Whyte Co....51
Linck, Henry 11
Lincoln Electric Co....55
Lindsley Brothers Company....43
Link Belt Engineering Co....67
Liverpool & London & Globe Ins. Co....
Locke, Fred M....21
Lombard Water Wheel Gov. Co....39
Lukenheimer Co., The....68
Lynn Incandescent Lamp Co....3

Machado & Roller....21
Mailloux, C. O....45
Maintenance Co., The....55
Main Belting Co....
Manross, F. N....
Maris Brothers 65
Marshall, William 72
Mason Tele. Pay Station Co., The....48
Massachusetts Chemical Co....1
Mayer Electric Co., Maxwell M....57
McGowan Co., The John H....68
McIntosh Battery & Optical Co....23
McIntosh, Seymour & Co....66
McIntire Co., The C....3
McLennan & Co., K....40
McRae, A. L....45
Meyrowitz, E. B....
Michigan College of Mines....21
Mica Insulator Co....30
Michigan Electric Co....4
Michigan Pipe Co....30
Miller Improved Gas Engine Co....
Modern Electric & Mfg. Co....21
Moloney Electric Co....
Mona Mfg. Co....31
Monson-Burmah Slate Co. 72
Montauk Multiphase Cable Co....7
Moon Mfg. Co....54

Moore, A. F....1
Morris Arc Lamp Co....11
Mt. Washington Glass Co....22
Munsell & Co., Eugene....30

National Carbon Co....
National Conduit & Cable Co....
National India Rubber Co....1
New England Butt Co....68
New England Motor Co....
New Excelsior Dry Battery Co....47
New York Central R. R....13
New York Insulated Wire Co....1
New York & Ohio Co....1
New York Telephone Co....43
North Electric Co....52
Northern Electrical Mfg. Co....29
Northwestern Telephone Mfg. Co....49
Norton Electrical Instrument Co....17

Okonite Co., Ltd., The....1
Onondaga Dynamo Co....
Osterberg & Sutton....45
Ostrander & Co., W. R....21

Pacific Electric Co....10
Paiste Co., H. T....25
Pass & Seymour....5
Patent Record 42
Peerless Rubber Mfg. Co....30
Pelton Engineering Co....43 and 45
Pelton Water Wheel Co....29
Pepper & Register....45
Peru Electric Mfg. Co....2
Pettingell Andrews Co....22
Phelan, D. W....2
Philadelphia Mach. Screw Works....69
Phillips Insulated Wire Co....30
Phoenix Automatic Filter Co....
Phoenix Glass Co....1
Phosphor-Bronze Smelting Co....68
Pittsburg Glass Co....43
Pittsburg Transformer Co....
Potter Co., F. D....66
Pratt Institute ....
Pratt & Whitney Co....70
Preston, Cohen & Co....2
Priestman & Co....68
Prindle Pump Co....40
Pringle, W. T....42
Proposals ....40 and 45
Purdue University 3

Queen & Co., Inc....4
Quimby, William E....69

Raster Carbon Rheostat Co....13
Rawson Electric Co....49
Reckenzaun, Fred'k 45
Reid, Thorburn 45
Reisinger, Hugo ....
Ridgway Dynamo & Engine Co....
Riker Electric Motor Co....1
Roberts Electric Supply Co., H. C....
Roche, William 47
Rockwood Mfg. Co....
Roebling Sons' Co., J. A....
Rosenbaum, W. A....39
Rossiter, MacGovern & Co....41 and 44
Roth Brothers & Co....55
Rouseau's Electrical Works, Inc....2
Royal Electric Co....23
Rushmore Dynamo Works....3
Ryle & Co., Wm....

Sachers, Ralph Julian....39
Safety Third Rail Electric Co....63
Salem Iron Works....47
Samson Cordage Works....30
Sargent & Lundy....45
Sawyer-Man Electric Co....
Schieren & Co., C. A....1
Schmidt & Bruckner Electric Co....46
Schoonmaker, A. O....2
Schwalm Co., George F....42
Sebastian Lathe Co....70
Seneca Falls Mfg. Co....21
S. E. I. Co....42
Sheaff & Jaastad 45
Shapiro & Aronson....10
Shultz Belting Co....1
Stewart Electrical Co....

Continued on Page 22.

THE TRIUMPH ELECTRIC CO.,

CINCINNATI, OHIO.

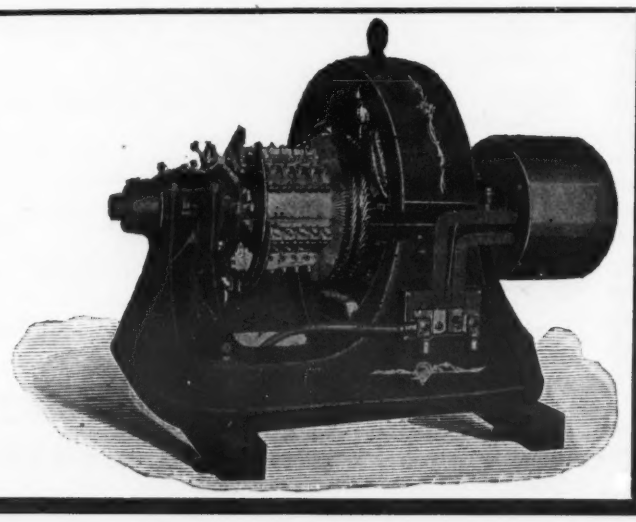
Belted and Direct Connected

Generators and Motors.

Slow and Moderate Speed.

For Railway Power and Lighting.

Write for Bulletin A.



Does

QUALITY

AND

EFFICIENCY

count with you on high voltage work?

If so, you will specify LOCKE INSULATORS.

Send for Catalogue No. 4.

FRED. M. LOCKE, VICTOR, N. Y.

MICHIGAN COLLEGE OF MINES
A State Technical School. Practical work. Elective System. Summer term. Every graduate employed. For catalogues, showing occupation of graduates, address MICHIGAN COLLEGE OF MINES, Houghton, Mich.

When writing to advertisers mention ELECTRICAL WORLD AND ENGINEER.

W. R. OSTRANDER & CO.,

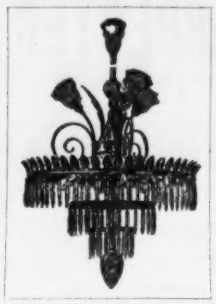
MANUFACTURERS OF

Electric Bells,	*Speaking Tubes,*	*Pneumatic Bells,*
Burglar Alarms,	*Elbows,*	*Pneumatic Dispatch Tubes,*
Annunciators,	*Whistles,*	*Mechanical Bells,*
Gas-Lighting Burners,	*Mouthpieces,*	*Spark Coils.*

EVERYTHING FOR HOUSE, HOTEL OR FACTORY USE.

FACTORY, 1423-1425 DE KALB AVE., BROOKLYN. 22 DEY STREET, NEW YORK

Strong, but not Glaring,



Frink's Silvered Corrugated Glass, while reflecting **all** the light, is the **most perfect diffuser** of light known. Its use for the reflecting surfaces of

"The Great Church Light"

insures every part of the church being lighted evenly. The size of the reflector and the number of lamps used determines the brilliancy of the lighting, but no matter how many lamps, there is no disagreeable glare from this system of lighting.

Used in over 20,000 Churches.

BOOK OF LIGHT AND ESTIMATE FREE.

I. P. FRINK, 551 Pearl St., New York.

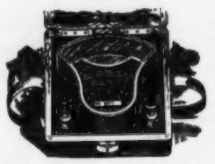
Let us explain our new plan for selling advertising space.

IT GETS BUSINESS FOR YOU!

ELECTRICAL WORLD AND ENGINEER,
120 Liberty Street, New York.

WHITNEY INSTRUMENTS OF PRECISION.

MACHADO & ROLLER,
203 BROADWAY,
NEW YORK.



"KOH-I-NOOR" CARBONS.

F. HARDTMUTH & CO., AUSTRIA, GERMANY.

Machado & Roller,
203 BROADWAY,
New York.

WE CANNOT TELL YOU

all we would like in this limited space, but our catalogue is full of illustrated and descriptive matter relative to

VOLTMETERS, AMMETERS,

for both direct and alternating currents.

POLARITY INDICATORS and ARC LIGHT VOLTMETERS and GROUND DETECTORS.

"COMBINATION PORTABLES"

Available for both direct and alternating current.

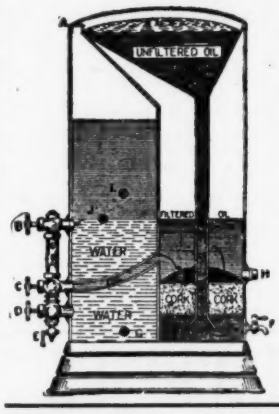
Keystone Electrical Instrument Co.,

CHICAGO: 315 Dearborn St.
NEW YORK: 15 Cortlandt St.
BOSTON: 170 Summer St.
901 Montgomery Ave., PHILADELPHIA.

MANUFACTURED BY

Kosmic Oil Filter Co.

EASTON, PA.



We will send one of our filters to any responsible party, at any point in the United States, on a thirty days' trial.

We Guarantee our Filter for five years.

STAR FOOT AND POWER LATHES

With Automatic Cross Feed, Compound Rest, Friction Counter-Shaft, Etc.

For Electrical and Bicycle Work, Tool Makers and Gunsmiths, Technical Schools, and Fine Accurate Machine Shop Service. Send for catalogue B.

Seneca Falls Mfg. Co.,
422 Water Street,
Seneca Falls, N. Y.

If it's "MODERN" we make it.

ASK US.

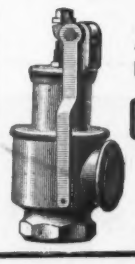
MODERN ELECTRIC AND M'F'G CO.,
CLARK & INDIANA STS.,
Chicago, Ill.

PROMPT SHIPMENTS OF ALTERNATING CURRENT DESK and BRACKET FANS.

EMERSON ELECTRIC MFG. CO., ST. LOUIS, MO., U. S. A.

CROSBY STEAM GAGE AND VALVE CO.

STEAM ENGINE INDICATORS.
GAGE TESTERS.
PRESSCUP GAGES.
VACUUM GAGES.
ORIGINAL SINGLE BELL CHIME WHISTLES.
FEED WATER REGULATORS.
WATER RELIEF VALVES.
BRANDEN RUBBER PUMP VALVES.
LUBRICATORS, ETC.



APPROVED and ADOPTED BY THE U. S. GOVERNMENT.

Crosby Pop Safety Valves

ARE A PERFECT PROTECTION FROM EXCESS OF STEAM PRESSURE.

SPRING-SEAT GLOBE AND ANGLE VALVES.

All Working Parts Renewable.

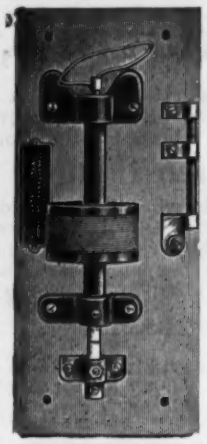
GUARANTEED NOT TO LEAK AT HIGH PRESSURES.

Made Yoke or Plain Top.

Iron or Brass Bodies.

Stores: 95 Oliver St., BOSTON. 78 John St., NEW YORK. 21-23 W. Lake St., CHICAGO. 75 Queen Victoria St., LONDON.

Office and Works, BOSTON, MASS.



STREET RAILWAY STATION ARRESTER.

THE GARTON
LIGHTNING ARRESTER
Is the Standard Everywhere.

DURABLE,
RELIABLE,
EFFICIENT.

11 Different Styles and Types.

For both Alternating and Direct Current of any voltage.

For Circulars, Prices, Etc., address your dealer or

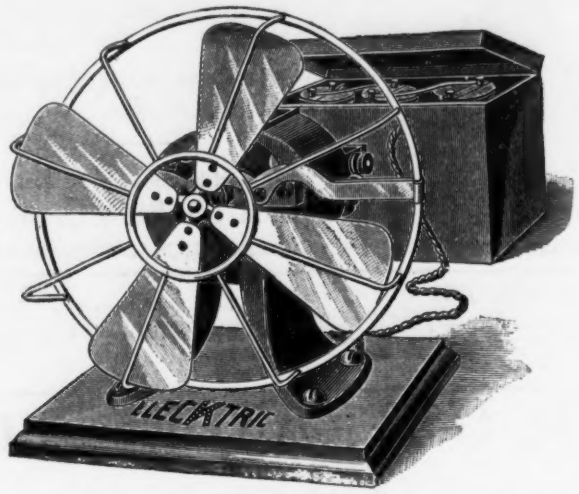
GARTON-DANIELS ELECTRIC CO.,
KEOKUK, IOWA.

"HARDY" INCANDESCENT LAMPS.
HARDY LAMP COMPANY, PITTSFIELD, MASS.

ELECTRICAL SUPPLIES.
Pettingell Andrews Co. 275 Devonshire St. / 5 Winthrop Sq. } Boston.
Leading Supply House of New England.

FANS For DIRECT, ALTERNATING and BATTERY CURRENT.

....DESK, CEILING AND WALL....



WRITE FOR CATALOGUE AND PRICES TO-DAY.

J. JONES & SON,
66 Cortlandt Street, New York.

ALPHABETICAL INDEX TO ADVERTISERS.—*Continued from Page 20.*

Shaw & Co., J. Elliott....2
Siemens & Halske Electric Co....61
Sills Mica Co., W. H....43
Simplex Electrical Co....1
Sipe & Sigler....13
Smethurst & Allen....45
Smith, A. T....57
Smith Interchangeable Tele. Co....48
Smith Co., Morgan....28
Specialty Mfg. Co....17
Sperry, B. N....4
Splitdorf, C. F....3
Standard Thermometer and Electric Co.. 9
Standard Underground Cable Co....72
Standard Telephone & Electric Co....54
Standard Electric Time Co....
Standard Paint Co....
Stanley & Patterson....1
Sterling & Son, W. C....39
Sterling Electric Co....50
Sterling Varnish Co....30
Stewart & Co., F. H....10
Stilwell-Bierce & Smith-Vaile Co....29
Stirling Company, The....66
Storage Battery Supply Co....45
Storey Motor & Tool Co....2
Stow Mfg. Co....69
Stromberg-Carlson Tele. Mfg. Co....53
Sturtevant Co., The B. F....16
Stucky & Heck....72
Telephone Mfg. Co....49
Thomas & Sons Co., R....39
Thompson, Edward P....
Thompson, Son & Co....42
Toomey, Frank....43
Townsend & Decker....39
Triumph Electric Co....20
Union Boiler Tube Cleaner Co....1
Union Hardware Co....2
Union Porcelain Works....47
United Correspondence Schools....39
United Electric Improvement Co....
United States Carbon Co., The....1
United Electric Heating Co....7
Utica Fire Alarm Telegraph Co....47
Valentine-Clark Co....53
Van Dorn & Dutton Co....43
Varley Duplex Magnet Co....3
Varney & MacOuat....42
Viaduct Electric Co....47
Victor Electric Co....57
Victor Telephone Mfg. Co....46
Vitro-Chrome Chemical Co....
Vose, Ralph....
Vulcanized Fibre Co....26
Wagner Electric Mfg. Co....9
Walsh's Sons & Co....43
Want and For Sale Ads....40 and 45
Ward Leonard Electric Co....9
Warren Electric & Specialty Co....16
Warren Electric Mfg. Co....61
Warren-Medery Co....57
Watkins, F. M....65
Watson-Stillman Co....66
Webster Chemical Co....25
Western Electrical Supply Co....
Western Electric Co....5
Western Telephone Constr'n Co....49
Westinghouse, Church, Kerr & Co....71
Westinghouse Electric & Mfg. Co....71
Westinghouse Machine Co....71
Weston Electrical Instrument Co....72
Wheeler Reflector Co....11
White & Co., J. G....45
White Co., The O. C....
Whitney Electrical Inst. Co....21
Williams Electric Co....49
Williamsport Wooden Pipe Co....13
Wirt Co., Charles....72
Worcester Polytechnic Institute....11
Worstall & Co., A. M....45
Worthington, Henry R....2
Wrought Iron Bridge Co....69
Wyckoff Creosoting Co....30
Young Mfg. Co., W. C....68
Youngstown Bridge Co....65
Ziegler Electric Co....11
Zimdars & Hunt....

MILLING and SCREW MACHINES of new design, for the manufacture of motors. Catalog. The Garvin Machine Co.,
Spring and Varick Sts., New York.

Mt. Washington Glass Co.,
NEW BEDFORD, MASS., U. S. A.

McCreary Silvered Reflectors: 7 in., 8 in., 9 in., 12 in., and 15 in.
McCreary Silvered Half Shades.
Complete Line of Incandescent and Arc Shades and Globes
Incandescent Bulbs and Glass Tube.

MT. WASHINGTON GLASS CO.,
Consolidated With
PAIRPOINT MFG. CO., New Bedford, Mass.

CEDAR POLES
ELECTRIC LIGHT.
TELEPHONE.
TELEGRAPH.
KITTREDGE, SMITH & CO., SHERBROOKE, P.Q.

Let us explain our new plan for selling advertising space.
IT GETS BUSINESS FOR YOU!
ELECTRICAL WORLD AND ENGINEER,
120 Liberty Street, New York.

CREAGHEAD ENGINEERING CO.
CINCINNATI, O.
Manufacturers of Arc Lamp Specialties, Trolley Line Material, Creaghead Flexible Brackets ARE STANDARD.